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ABSTRACT

This volume comprises the papers presented at the 1998 conference of the Pacific Telecommunications Council. This PTC'98 gathering focused on "Coping with Convergence." These 20th anniversary conference proceedings present at least one contribution on 59 countries and territories. The 120 papers in this volume are arranged chronologically, according to date of presentation. Topics covered in the papers include: total quality management; rural telecommunications; information policies; satellite/wireless communications; global fiber optic systems; national information infrastructure; regulations; universal services; access and interconnection; convergence in the workplace; Asynchronous Transmission (ATM)-based telemedicine; Internet Roaming; cellular mobile phones; deregulations/regulations; information cities; global searching; microwave radio links; service management; cable television and telephony; convergence of industries and services; information futures; competition; virtual classrooms; privatization; undersea cable developments; distance education; digital video; Internet industries; coding schemes; security; electronic government; voice mail services; and scrambling. Subject, country, and author indexes are included. (AEF)

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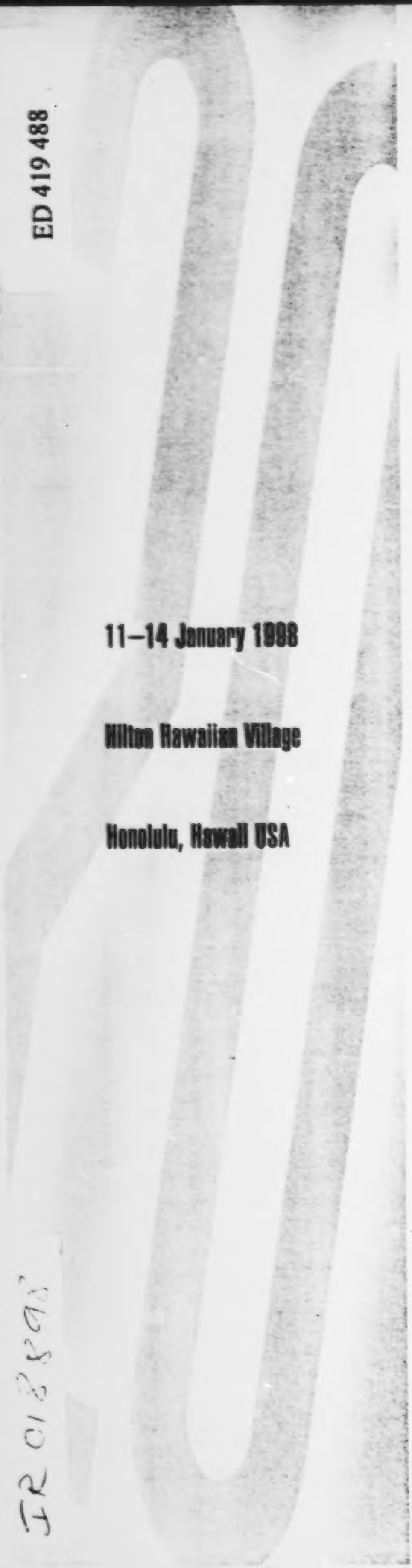

20th Annual
Pacific Telecommunications
Conference

PTC'98®

11–14 January 1998

Hilton Hawaiian Village

Honolulu, Hawaii USA

Proceedings

Edited by

Dan J. Wedemeyer and

Richard Nickelson

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Foreword

Welcome to the Pacific Telecommunications Council's (PTC) 20th anniversary conference! Have you decoded the proceeding's cover "orbit" yet?

PTC'98 is set to focus on **"Coping with Convergence"**. For most of us here, what we saw only a few short years and technical generations ago as the future, is now a day-to-day environmental reality. This environment continues to change and requires that we take on a spectrum of telecommunication learning as a lifelong survival skill. This conference accepts this responsibility seriously in its organization, content, quality and participant-networks dimensions.

Just as the way in which PTC is organized, we try to diversify our perspectives; geographically, organizationally and individually at the annual conference. This world-class four-day event facilitates information exchange on such areas as communication and commerce beyond the next decade, the human side of convergence, Internet Service Providers (ISP) in the Asia/Pacific, country mobile communication updates, etc.

This year we had more than 350 paper proposals submitted. After a "blind review" of papers conducted by twenty-two (22) PTC members from around the hemisphere, we selected the 120 papers contained in this volume. The "stellar" selections were then fashioned into the conference framework.

As editors of these proceedings we offer the following observations about the characteristics of this year's conference papers. First, many represent a focused, state-of-the-art update of some very specific aspect of the telecommunication field from a governmental, industry and/or academic perspective(s). The diversity of topics and the breadth of geographic/ economic/ social/ cultural/ political perspectives, and the strategic importance of selected papers, permits selecting "current interest" paths through the conference. They also allow sampling of new or (e)merging areas of interest. From a utilitarian standpoint, many of the papers address real problems and offer real and innovative solutions as well as setting conditions for research or insights which assist in organizational and govermental oversight or guidance.

Of the more than 175 subject index items, the various types of satellites (i.e. LEOs, MEOs, GEOs and DBS applications) rank highest. Paralleling these topics in magnitude are regulatory concerns/foci (i.e. deregulation, privatization, competition, liberalization). Such topics as development issues, multi-media, standards, PCS/cellular/mobile services, education/distance education, e-commerce, and WTO are significant classes of content in PTC'98.

These 20th anniversary conference proceedings present at least one contribution on fifty nine (59) countries and territories. Such a diversity of information and personal networking possibilities make the event central to telecommunication development in the hemisphere.

The past successes of PTC conferences are due to a large number of professional contributions. Central to all of these successes, however, has been the PTC staff and the annual conference committee. So, as editors of this volume, we want to offer a special *mahalo* to everyone involved in producing this first-class double-decade anniversary conference and in assisting with these proceedings.

Finally, we want to salute the PTC'98 participants who contribute to the high quality content and to the interactional successes of the event.

Aloha,

Dan J. Wedemeyer
Richard Nickelson
Honolulu, 1998

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Sunday, January 11, 1998

NOTES:

1997 Research Prize

PACIFIC TELECOMMUNICATIONS COUNCIL

Recipient:

David (Cyri) Jones,
Product/Market Manager
Dominion Directory Information Services
Canada

**"Information, Multimedia and Education:
The Need for an International Content Classification System
and Mark-Up Language"**

(See Session T.3.3.1)

Monday, January 12, 1998

NOTES:

Total Quality Management in CTC Mundo

William H. Neilson
Business Executive
CTC Mundo
Chile

1.Introduction

Ladies and Gentlemen, it is a great pleasure to be here in beautiful and sunny Hawaii, representing not only my Company CTC Mundo but perhaps, a large cross section of PTC members from Latin America that are not always well represented in numbers at these events. We at CTC Mundo in Chile believe that this annual seminar represents one of the best opportunities to promote and share findings and achievements but most important, to maintain that friendship that so well characterizes one of the aims of every participant here present.

In CTC Mundo a subsidiary Company of "Compañía de Telecomunicaciones de Chile" (CTC), we are responsible for all long distance traffic both national and International in one of the most competitive environments in todays world.Through our association with our major shareholder TELEFÓNICA DE ESPAÑA we have become part of a global telecommunications infrastructure encompassing significant strategic alliances with major telecommunications partners such as BT and MCI.

The economic growth experienced by our Country in the latter years, has demanded Companies a great effort to maintain themselves at the forefront in their respective areas. In CTC for example, the average investment for the period 1990 - 1996 reached annual levels of US $ 489 million. The largest private investment program ever accomplished in Chile.

Since TELEFÓNICA DE ESPAÑA became the major shareholder, CTC has experienced steady and continuous growth and diversification into all areas of the Telecommunications business. As a consequence of this major investment program, the telephone density has increased from 6,6 lines per 100 population in 1990 to 14,3 in 1996 in a 100% digital network, Plan 2000 calls for 3 million lines by the year 2000.

We firmly believe that in order to compete in today's world, quality has to be considered synonymous with excellence and in order to achieve this, it is necessary to permanently review the way we do things , the way we design our processes, and our management style. We seek to satisfy the consumer by incorporating his needs into the design, production and delivery of the products and/or services furnished by the company. This indication, quite simply enunciated, constitutes the core part of a company's competitive strategy and its revenue source.

The approach taken by our Company to introduce the concepts of Total Quality Management(TQM) and continuous improvement, are based on the fact that quality is judged by Customers. All products and services characteristics that contribute value to customers and lead to customer satisfaction and preference, must be a key focus of a company's management system.

Change and our ability to deal with it, is now a reality of organizational life.Competition is here and now. If we are to satisfy our customers , it is no longer enough to keep doing what we've always done in the past.

A key strategy adopted by the Company, has been to focus on the principles of Quality management and Continuous improvement.We believe, that our efforts to employ a methodological and analytical approach, are the first attempt in Latin America to introduce this concepts in a Telecommunications Company.

CTC, The Holding Company aware of the strong competition being experienced in all fronts of the Telecommunications industry, opted for a TQM program as part of the process of change being introduced and lead by our General Manager.This process of change, consists of a re engineering phase in some of our major processes and TQM throughout the whole organization encompassing some 9000 workers.Two external consulting Companies were hired to train, review and assist in all facets of the re engineering and TQM programs.The following paper will describe some of the practical aproach taken by CTC Mundo with its TQM program.

2.1 CTC Mundo Organizational Structure.

CTC Mundo commenced its Commercial operations on the 27th of August 1994 when by government decree it received a licence as an International/National Carrier Operator.

It is headed by a General Manager and employs some 500 people organized into 3 functional areas each headed by an area manager.Within these areas, we distinguish Technical and Operations, Commercial and Sales and Human Resources and Finance. Within its workforce, there are some 200 people employed as telephone operators and telephone assistance Operators. CTC Mundo, is characterized by a young and motivated professional workforce.

2.2 TQM Organization

The TQM organization, is headed by a Corporate TQM Committee lead by the Corporate General Manager and integrated by 6 Senior Vicepresidents. After having commenced the TQM program in January 1997, we presently have 22 TQM committees working, one in each of the business units comprising the whole of the Corporate business Organization. In CTC Mundo, the TQM Committee meets on a fortnightly basis evaluating and guiding the program and the progress made by the Team Oriented Problem Solving Groups (TOPS). A quality manager performs the coordination work and guides the TOPS through the process of defining the project, identifying the problem, its causes, the selection of the best solution and the preparation of the implementation plan.

2.3 Points of No Quality (PNQ'S)

During January 1997, the consulting Company hired to guide the Company through the TQM program recommended that we initiate the process, through an activity that would incorporate the whole of the workforce contributing with their opinion,an idea or a simple thought on aspects that they were not happy with. The concept of a PNQ was introduced and defined as whatever they thought did not work properly or could be improved, modified or altered in search of better performance in process, personal satisfaction, internal/external customer satisfaction etc, This is aimed at introducing over the long term, a filosophy for continuous improvement.

To obtain feedback on PNQ'S, The whole Company was divided into 35 groups of 15 people. A suitably trained mentor was assigned to each group with the responsibility of addressing the importance of orientating the Company towards a continuous improvement program and a Total Quality Management System.

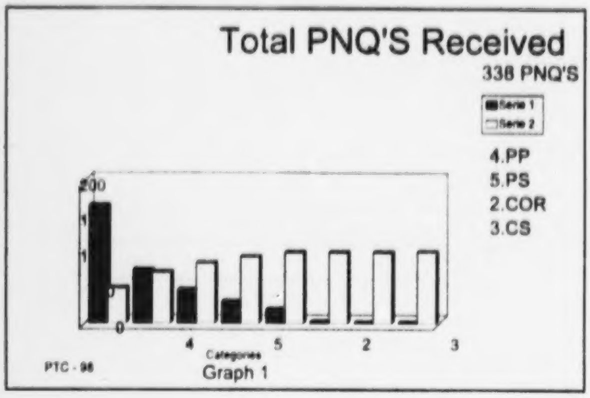
A four hour presentation was prepared with the assistance of the external consulting Company,it focused on the activities and processes of each of the participating groups. The groups were then given a month to submmitt Points of No Quality (PNQ's).

2.4 PNQ'S Classification.

A total of 338 contributions were received and classified in accordance with a Corporate procedure that recommended classification into 8 types of PNQ'S.

1.Total Quality Management Program (TQM)Implementation.
2.Corporate Aspects
3.Customer Satisfaction (Internal/External)
4.Process Productivity.
5.Employee satisfaction
6.Social Impact
7.Business Results
8.Quality Assurance

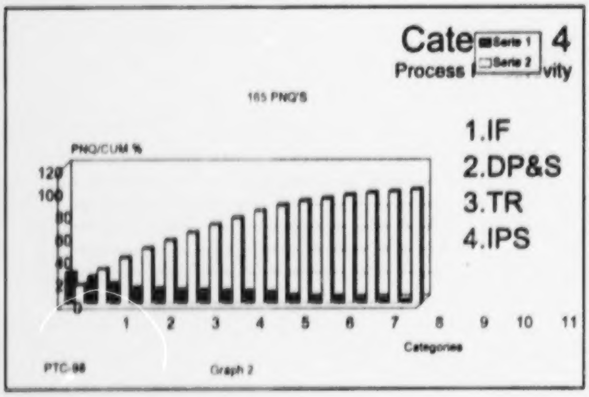
Item 6 addresses how the Company integrates its public responsibility and corporate citizenship into its business planning and performance improvement practices.



Graph 1

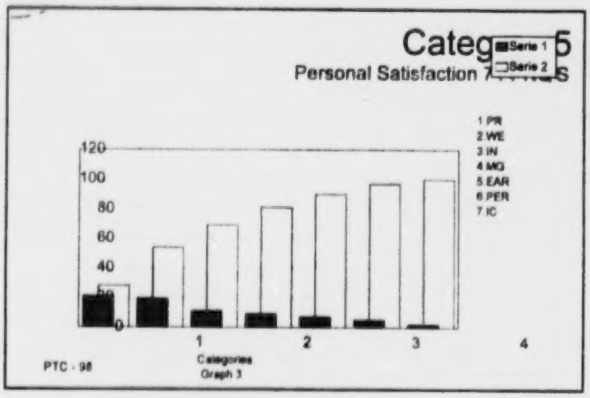
Graph 1, shows the % distribution for the initial analysis of PNQ'S indicating that 80% of the contributions are concentrated into the following three factors: Productivity of Processes (PP), Personal Satisfaction (PS) and Customer Satisfaction (CS).

A closer analysis on factor "Productivity of Process", is shown in **Graph 2** indicating that 1.Information Flow (IF), 2. Data Processing and systems(DP&S) and 3.Training(TR), are the major components responsible for 50% of the PNQ'S received and therefore, a starting point for the work to be performed by the Team Oriented problem solving group (TOPS).



Graph 2

A closer analysis on factor " **Personal Satisfaction** ", is shown in **Graph 3** indicating that 80% of the PNQ'S are related to the following components: 1.Promotions(PR), 2.Work Environment (WE), 3.Incentives (IN) and 4. Management (MG).



Based on the PNQ'S received, the analysis performed and general guidelines from our business plan, 8 TOPS were formed to recommend possible courses of action to the Quality Comittee, in the following areas of concern:

1. Information Flow
2. Training and new products
3. Contractual aspects with suppliers
4. Complaints (Two Teams)
5. Billing (Two Teams)
6. Human Resources

The first five areas of concern, are related to "Productivity and Processes" and the 6th one, to "Personal Satisfaction".

2.5 Rapid Deployment Force.(RDF)

One of the first tasks performed, was to identify all those PNQ'S that could be easily resolved within a minimal timeframe. An RDF type of group was set to classify and propose solutions, mainly to generate a general feeling that a quick action had been taken in response to someone's contribution.

3.Problem solving methodology.

A team oriented problem solving procedure was adopted. A senior manager was asigned to each of the 8 groups with the responsibility of guiding the group and attaining results within a given timespan.Table 1 shows the steps followed, commencing with the identification of the project

Table 1: Problem Solving Methodology

Phase	Objective	Steps	Tools/Techniques
Define Improvement Project	Clarify the project and how it can be verified with data	1. Context 2. Customer's point of view 3. Indicators	Historic data Customer/Supplier diagram Tendency Graphs Bar Charts
Identify the Problem	Divide the process to identify weak areas where the TOPS should concentrate	1. Divide process 2. Clarify the problem 3. Define objectives	Flow diagrams Pareto Diagrams Histograms Consensus Customer needs Benchmarking
Search for causes	Identify causes originating the problem	1. Search for main causes 2. Examine main causes 3. Checking/Validating 4. Problem and causes matrix relation	Ishikawa diagram Correlation diagram
Find Solutions	Select and apply solutions to eliminate causes	1. Choose solutions 2. Plan its implementation	Solution Matrix Cost Benefit analysis Action Plan
Measure the improvement	Measure the effectiveness of the improvement recommended	1. Effectiveness of the solutions 2. Relationship to process 3. Normalize improvement	Pareto diagram Histograms Norms and procedures Flow diagrams Control diagram Tendency diagrams
Perform the balance	Verify team progress and process effectiveness	1. What have we learned 2. What have we got to do different 3. What actions to take 4. Next steps	Consensus Pareto diagram PDVC

and finally setting up control indicators to measure the improvements, including a comparative analysis between the starting and the final stage.

4.Results

The Corporation's target, was to save us $ 1 million in 1997 throughout the work of the 22 quality committees and the 126 TOPS in operation. For 1998, the number of Quality Committees will be increased from 22 to 36 and the number of TOPS will be in the vicinity of 600. It is expected that not less than 5000 employees will have gone through the experience of working in TQM by year end 1998.

Customer satisfaction is to be in excess of 80% and savings to the value of us $ 15 million in 1998.

We have not yet quantified monetary results for the 1997 financial year however, we can certainly agree that we have improved in the following aspects:

On time training
Improved information flow
Better control of processes
Management by data and performance indicators
Establishment of a commitment network
Motivated workforce
systems oriented approach

We envisage that by year end 1998, we will have a clearer view as to the real savings in our operational costs. It is our view that the real gain is related to a change in culture and work attitude where willingness and concern among the workers is oriented towards the customer needs and the Company's objectives.

5. Conclusions

Ladies and gentlemen, may I conclude by saying, that the last decade has witnessed in Chile, one of the most remarkable achievements ever performed by private investment in the development of a modern and efficient network infrastructure capable of providing, the most modern and up-to-date telecommunications services in the world.

We are concious that success in the past does not necessarily guarantee success in the future and on this basis, CTC is developing the necessary strategies to make sure that all the appropriate steps are taken, in order to develop not only the network infraestructure in accordance with the requirements of a modern and demanding corporate community but also and most important, the managerial workforce required for todays complex and competitive world .

Mainly our Company, focused its program on the following primary objectives:

1.Permanent orientation towards the satisfaction of the customer's needs
2.Continuous improvement of processes
3.Effective participation of all employees.
4.Continuous training on new abilities.

After having identified our objectives and actions from the contributions received in the form of PNQ'S, business plan and Corporate guidelines, we are now in the process of forming TOPS. These tasks in the form of objectives and actions constitute our 1998 Quality Plan. Our experience indicates that in our first 6 months of operation internal communications have improved, complete processes are better understood and commitment between internal customers has greatly improved.This is generating a well defined environment for continuous improvement to be seen as the normal way to function and work.

For continuous improvement to be effective, we must take the time to plan and make a critical evaluation at what we are doing and how well we are doing it.This must become an important and ongoing activity, bearing in mind that achievement of the highest levels of performance requires not only, a well executed approach but participation, commitment, team approach and leadership at all levels of the organization.

We believe that often it is not work that really bothers us but worries , frustration and resentment derived from it. We expect to generate the working conditions that will pave the way for a creative, motivated and entrepreneurial workforce.

Rural telecommunications: devising a contemporary policy framework

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Abstract

Structural reforms introduced in the telecommunications sector in developing countries including privatization or competition and the advent of new services and access technologies raise some questions for the future of rural telecommunications. This report describes the economic implications and viability criteria leading to the adoption of unrestricted expansion policies,and the right of the rural population to get access to the same services provided to urban areas at equitable costs. Based on such criteria, a technical recommendation was recently submitted to the regulatory body of Argentina (CNC) during a series of public audiences held nationwide. The proposal aims to assist the process of planning and implementation of a contemporary long-run rural policy framework.

1. Introduction

Among the heaviest problems remaining unsolved in developing countries, the provision of telecommunications services to rural areas has been pointed out as a key goal since 1985 when ITU's Maitland Commission submitted an historic report ("The Missing Link"). The privatization-competition era and technology changes diminishing access costs have brought about the need of devising a different, contemporary framework policy for the expansion and operation of rural networks.

Some of the concepts of this paper and former ones (7,10,11) gave support to a technical recommendation submitted by GTR-UNNE to the National Government of Argentina in June,1997 during a series of regional public hearings organized nationwide by Secretaria de Comunicaciones (National Communications Undersecretariat). The recommendation, previewed during another national meeting in Tilcara, Jujuy summarizes the directions and procedures envisaged as necessary for designing strategic action plans for rural networks in our country for the period 1997-2007, as follows:

1) The Right to Communicate.
2) The Unrestricted Expansion approach.
3) The Rural/Urban Equity concept
4) The Intra-regional Equity concept
5) The Use of Standard, Mass-Produced Equipment
6) The Non-discriminatory Technological Policy.
7) The Dynamic of the Rural Network
8) The Rural Service Viability
9) The Network Strategic Evolution Model
10) The Pilot Area Rural Projects

2. The right to Communicate and the Rural World

In 1994 in Argentina, the National Parliament approved a Declaration on the right of the rural population "...to have access to the basic residential telephone service on a quality-and-cost-equality basis respect to the one currently provided to urban areas; by using whatever technologies and systems worldwide available, and by taking advantage of whatever suitable option allowed by the regulatory framework, aiming to achieve a massive and balanced expansion of the network nationwide"(1). This was short time after the release of the WTDC-94 Final Draft and the Buenos Aires Action Plan (BAAP), including the initiatives of the Integrated Rural Development program -Program Nr.9- (2).

There is not much disagreement about the concern and origin of the right to communicate of the rural population (3). Yet, the practical implications leading to exercise such right are quite controversial, as primary development issues such as universal service, socioeconomic impact of telecommunications, rural development priorities and financial feasibility. A general, long term goal should take into account 3 main variables concerning the practical exercise of the right to get access to telecommunications by rural inhabitants:

- the availability of the services
- the quality of services
- the cost of the services to be provided.

The mutual relationship of these factors is actually more than just a kind of zero-sum game, taking into account technological advances and liberalization/ competitiveness trends in the regulatory framework. Undoubtedly, reaching whole areas or the whole population of a given region implies a high level of commitment in both the quality and the marginal cost.There are several grades of availability with associated quality of service and cost, e.g. from just a public telephone or coinbox everywhere in a developing region at less than 1-hour walking or biking (Hudson, 1995)(4) to perhaps, 100%

residential rural/urban access within any industrialized country. Moreover, public access concerns to service hours and days of attention at public call offices (PCOs), the need of different payment methods -cash/ coins, credit cards, magnetic or chip cards, tokens etc.-as well as the average waiting time to place or receive calls from them, as limiting factors.

Likewise, the quality of service may range from e.g. a noisy SSB/HF, operator-assisted semiduplex line serving an island just for emergency voice calls, to the latest V.34 modem access line suitable for multimedia-color videoconferencing sessions at a rural technical school. Correspondingly, the marginal cost associated to the extension of telecommunications to rural areas (expansion cost and operations cost) and their tariff level should match with the quality and availability of the services provided. Not only new technologies and services but also new tariff arrangements should be tested in pilot trials, as recommended by ITU-UNESCO in the 1994 joint document 94/4-E (3)

3. Rural Telecommunications and Universal Service

From a general outlook, the relationship between rural communications and universal service has been precise about their regulatory and social implications, such as the right to communicate. Some documents submitted to ITU's I World Telecommunications Development Conference (WTDC-94) shed light on these issues and provide guidelines for initiatives in both industrialized and developing countries. In 1995, the U.K. regulatory body (Oftel) defined the concept of Universal Service as "affordable access to basic voice telephony (or its equivalent) for all those reasonably requesting it regard -less of where they live" (5). Although this is related to the conventional sense of the Universal Service, Oftel addressed another regulatory question concerning the need of definitions about an "institutional dimension" of the Universal Service referred to the provision of a higher level of services (mainly IT services) as a mid-term goal for schools, libraries and training centers.

In the same year in USA, the NTIA (National Telecommunications and Information Administration) went far beyond by defining goals for the so called RII (Rural Information Infrastructure) as a part of the NII and the GII (6). To a extent, the proposed RII as a long-term project should be seen as a continuation, into a different context of the same universal service regulatory policy pursued in the USA as explained in the 1934 Communications Act released by the Federal Communications Commission (FCC):"to make available, so far as possible, to all people of the United States a rapid, efficient nationwide and worldwide wire and radio communications service with adequate facilities at reasonable charges" (5). This shift of the basic ideas of Universal Service towards the requirements imposed by the information era also appeared in other reports e.g. in 1995 from the Canadian Highway Advisory Council (IHAC). Recently in Argentina, a presidential Decree -Nr. 554/97 addressed the affordable provision of Internet access to schools, libraries, universities and the health care system. It was included as a mission of the framework of the regulatory body (*CNC = Comision Nacional de Comunicaciones*).Likewise,the rural service is nowadays a sort of multi-leveled reality in the same sense that the Universal Service is discussed in Hudson (4). She described it as a "moving target", so the requirements not only concern household access availability (level 1), but also community access -e.g. through community teleservice centers (CTSC) (level 2) and institutional access (rural schools, paramedical service, etc.(level 3)-. Within this framework, near-term goals might be different for industrialized countries than for developing ones. The first goals should assess universal provision of Single Party Touch-tone (DTMF) and fully digitized switching; service quality suitable for facsimile and data communications; rates based on communities of interest -taking into account calling patterns of rural subscribers-; enhanced emergency services (E911); and access to optional information services -involving access to remote servers and databases at a local-call costs-. Meanwhile, developing countries should address: universal basic service, at least on a public basis within walk distances from every rural resident; reliability and quality standards sufficient for voice and fax; regular emergency services; and pricing schema based on communities of interest.

It is important to devise a strategic model of the evolution of the network. This model should include an *Expansion plan*, an *Operations plan* and an *Insertion plan*.(7). In addition, pilot rural area projects, such as Community Teleservice Centers (CTSC), should be considered to test feasible ways to bring the service in rural locations (8,9,10).

Another key issue arises from the implications of the availability related to the equity of network expansion processes. As a general goal, equity trends should influence the long-run goals of each country, region or service zone. This concerns the number of new subscribers and the number of lines involved in different stages of the network evolution. To some extent the regulatory framework should permanently seek such goal by keeping a dynamic arrangement of multiple stage equilibria:

a) The relationship between the marginal growth of rural vs. urban lines at each stage of the expansion process.

b) The whole telephone density status in different regions of the service area and among different provinces and zones of the country.

Such equilibria are related to the property of any telecommunications network to act as an intra-regional balancing element between the forces of the market and the development of the economy, as in the concept of Robert Preece (12). Moreover, while the urban network is often seen as having a very static deployment pattern, in rural areas the word is dynamics Since rural customers use to change location, type of service, etc., the plan should foresee frequent changes like adding, discarding and modifying of subscribers.

4. Expansion Plans: Traditional Approaches

At the time the Maitland Commission submitted its report, the expansion of telecommunications networks to rural areas used to rely on implicit restrictive policies Traditionally, operators foresaw the deployment of infrastructure to cover specific targets within rural areas as limited just to public payphones or scarce groups of high-income subscribers. Specific radio and switching equipment required used to be expensive on a cost-per-line basis, while often featuring low capacities and inherent traffic or service constraints. Typical expansion plans did not aim at covering whole rural service areas nor at adding thousands of new lines to the network, but rather to create a number of scattered "rural access points" leading to shorten the average distance from every inhabited location to the nearest telephone. This policy was undertaken in the period 1970-1990 in the national plans of e.g. India, Mexico and Costa Rica (11) There were no technologies suitable for large projects (>10,000 lines) and just a few options for medium size (1,000 to 2,000 lines) mainly with TDMA digital point-to multipoint mux radios operating in the 1.5/2.4 Ghz microwave bands.The up front investment required just for the transmission segment led to typical per-line costs 2 to 5 times above the neighboring urban areas'averages.Hence, these transmission platforms remained as useful only for high-income clustered subscribers in outstanding regions but not for the normal, scattered pattern of small farmers or cattle breeders living in low income areas and developing countries.

Furthermore, the problem was not the technology but rather the strategic concept of the rural expansion within the *top-down* criterion: suppose that an hypothetical operator serving a region with rural areas was able to afford the cost of the "x" and/or the "y" technologies; then he assessed the number and location of the prospective subscribers suitable to be connected by the "x" and/or the "y" link types. From this technology-bounded set, only those residents capable to reach a minimum traffic threshold and to share the up-front investment required to make the line viable will be finally included in the prospective expansion plan. The remaining set -eventually ranked as unable to afford the per-line costs- will be simply discarded, even when historically comporting the vast majority in developing countries. Consequently, the target was on a limited, profit-only customer base; moreover, such profitable customers might be already served by other alternative options (pagers, 2-way radios, etc.). As a result, neither the number of the newcomers will be so high nor their traffic profile will be so lucrative-as partially bypassed through alternative media- to keep the per-line price within reasonable averages. A vicious circle feeds on this conservative approach with corresponding high costs per line added few subscribers with just moderate traffic expectancy, low marginal revenue capacity and obviously, too limited resources to undertake further extensions of the network to next unserved zones.

5. Risk Assessment and Unrestricted Expansion

Instead of this restrictive approach, we could devise a *"bottom-up"* criterion whose initial assumption is not any particular technology, but a mandatory expansion goal involving a large set of new subscribers suddenly incorporated into a kind of fast, sharp and massive expansion. From this non-negotiable assumption (rapid incorporation of a large set of new rural subscribers) we would seek afterwards the best technologies for the particular region to be served, the best engineering criteria and the right deployment strategy leading to optimal per-line marginal costs. Obviously, there is a need of capital to cover the up front investment and possibly, any negative cashflow periods. But experience has shown that large scale projects often got better technologies and better final prices. This arises from bidding from wider and more diversified baskets of suppliers, better delivery conditions, larger volume discounts, long-term financial options and better supply warranties or maintenance agreements.

So the question is about the risk involved in providing network access to many subscribers with unguaranteed traffic behavior and limited income, and the way that the enhanced network would provide the required rate of return to make it economically viable. To understand this point we can compare both expansion approaches and their respective chances of success, in the same sense of what happens in the oil business. One can suppose that there is at least a chance of profitably striking oil by drilling just a few shafts according field surveys performed in a given area. In fact, a small company operating on a limited capital basis might be lucky enough to succeed at making money this way. But looking around, we could hardly find so many oil wells yielding benefits as a result of this approach. More likely, we will find either large oil companies or smaller ones associated in joint ventures to drill dozens or hundreds of shafts. The reason is very simple: there is less risk associated to larger sets of drillings -and a high chance to strike oil at least in one to cover costs- than the risk of small sets, because the probability of all drillings resulting unsuccessful is much higher therein. This is also a survival strategy: a single small company would be otherwise exposed to lose all its operating capital just after drilling on a few, unsuccessful places.

Fortunately, the expansion of telecommunications networks to unserved rural areas may be less risky than oil exploration and less capital consuming.In fact, there are hundreds of telephone cooperatives and small operators serving local (urban and rural) point areas in Argentina and other countries, in addition to pioneer rural providers in USA. In the last 20 years, different technology options and a sound change in terms of cost per line turned around the viability of local service, even in low-density and isolated spots. Nevertheless, we should consider the rural telecommunications business in the same sense as the oil business: the risk is always associated with the scale of the project and the best opportunities of success will come from those plans involving a large mass of new subscribers. The same approach gave rise to related projects like LEOS networks -the new, promising rural technology- but also to submarine cables, cellular and PCS initiatives. Let's consider just a couple of examples in Argentina:

a) In 1993, the second (B) band of cellular mobile service for inland areas was released for bidding. The bids were assessed according best territorial and population coverage,shortest installation and start-up time. Regardless of the unfavorable traffic forecasts and pessimistic studies reporting vast areas and towns as unfeasible for cellular demand, the winner proposal offered near 100% coverage with more than 1,600 villages and towns to be served from 900+ cell sites. Now the inland cellular service with 2 competitors is the largest growth business in the country.

b) In 1994, one of the main POTS operators submitted to the regulatory body (CNT) a proposal to install up to 90,000 rural fixed cellular lines within its service area *to be operated at the same tariffs as the urban residential service.*(13). This plan was ultimately not approved by CNT because the inland cellular company claimed that it could weaken its market during its 2-year exclusivity period, as long as the rural cellular network would be granted the same AMPS frequency bands.Of course, in 1996 when the "A" band was released to main telcos the rural plan might have been implemented anyway, but the incentive had definitely gone. Since the inland mobile operators would serve almost the same rural customers at cellular rates (600 to 1000% above basic rates), it was more profitable than the former proposal: the opportunity had gone and the rural project expired. Nevertheless, the importance of this case was not the final decision but the *willingness* of the POTS company to bring the rural fixed cellular service at *basic rates.* As in the cases of Parana (Brazil) and Galicia (Spain) both in 1993 the operators would not intend -supposedly- to waste their money in non-profitable projects, even with less sophisticated technologies than nowadays (13). From these examples there are twopoints to remark:

- Large scale projects in rural environments have been feasible and profitable in the long run despite many pessimistic forecasts (Inland/Rural cellular, CATV, etc.)
- A"technology discrimination"policy (not enabling the use of any particular technology in rural areas) is a limiting factor for expanding the rural networks.

6. Economies of Scale and Scope

As considered by the former ITU-CCITT (then ITU-R), there are at least three effects related to economies of scale in the telephone traffic engineering, associated to the extension of rural service to new zones:

1.- Due to non-linear properties of the Erlang formula, each channel on a large transmission trunk can carry on higher average traffic rates than another one on a small trunk, with the same loss probability. Hence, networks should better array as many channels as possible into fewer links to increase channel efficiency.

2.-Traffic fluctuations are greater in small trunks, due to the effect of non-coincident traffic peaks in trunks of different transmission routes (time of the day, day of week and month of the year). So wherever circuits of different sources can be grouped into a broader route - e.g. by digital concentrators or tandem switches- the total traffic of such route (T) will be lower than the aggregation of individual traffic values of each source (t_i) carried on separately:

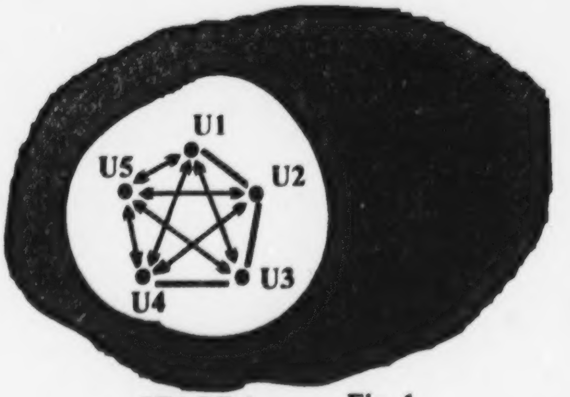
$$T < \sum_{i=1}^{n} t_i$$

3.- The cost per circuit in every transmission and switching system becomes lower for higher capacities. This arises from the relative weight of the fixed common equipment respect to the modular add-on circuit units in small switching/transmission devices.

A recent, comprehensive European report has pointed out (5) "economies of scale" as well as "economies of scope". It has to be remarked that the last ones arise from the ability of a particular network to provide as well additional services beyond POTS by using existing POTS infrastructure. An outlook of prospective mixed networks carrying e.g. cable TV services and POTS either by existing operators or entrant competitors (Lemay & Yates,1995) assessed extra costs above 40 % in the case of deploying them separately (14). By using right technologies as we discussed extensively in other papers (7,11,15), the Unrestricted Expansion concept can fully benefit from economies of scale and scope. What's more, the advent of digital local loop and cellular technologies might turn the transmission options to become the same for both urban and rural subscribers. We had repeatedly argued in favor of relying as far as possible the rural network expansion in such common, industry-standard, mass-produced infrastructure components. This equipment can be eventually adapted for rural use. Special, proprietary design or niche products unable to reach up-front and operating costs similar to urban lines should be limited to cover the "peripheral" requirements such as isolated subscribers far from every exchange, VSAT local loops, solar powered subscriber premises, etc.(7,11).

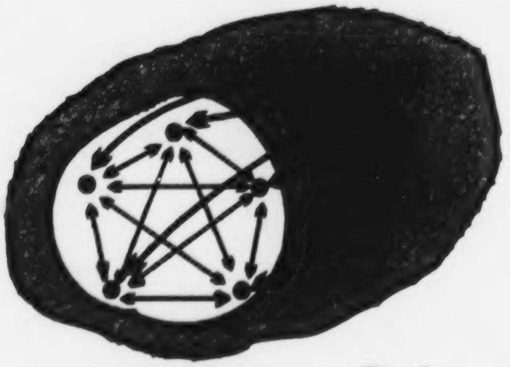
Within a regulatory framework fostering massive expansion policies, and subsequently promoting volume infrastructure deployment and investment, *the rural telephone lines within any region should not cost more than the urban ones in the same area.* Hence, it is hard to support anymore those arguments claiming massive subsidies to bring the service to rural areas on the basis of the supposed extra costs per subscriber line respect to the neighboring urban network. Of course, it may not be the case of rural cooperatives and small operators serving point areas where the *scale* is not enough to meet viable operation. But the idea is to let the rural service be viable for the whole country or region, not on the scope of any particular local area. Compensation for the differences is a regulatory matter which arises from the previous sequence of development of a given network (16).We addressed this issue by describing the *topological memory of the network.* (11,15). Hereforth, it is useful to see some evidence supporting the concept of Unrestricted Expansion.

7. Viability of the Unrestricted Rural Expansion



STAGE 1 Fig. 1

As in the concept of William Melody (16),viability assessments in the case of expanding the network to rural areas pursued under a misleading procedure, which assigned all the costs of the systems expansion to be shared among the new added lines, while only their outgoing traffic and line charges are taken into account to calculate revenues. There is strong evidence that such a procedure is wrong and that concrete economic and uneconomic benefits can be drawn from the extension of the network to rural areas.The point has been considered within a 1996 EU report about cohesion aspects of the information society (5). Concerning the economic benefits, an incremental analysis of the rural expansion should take into account a different assignation criterion of the marginal costs and the effect of the network externalities. Let an imaginary local network comprising 5 subscribers to evolve within a 3-stage expansion plan covering rural areas with 2 prospective subscribers (R1 and R2) within the licensed service zone (Fig.1). Let every subscriber to be able to call anyone else with the same probability and let the calls to be rated, depending on the location of both subscribers as "local"(1 traffic unit each) or as "short distance"(1.5 traffic units each). For a network having *n* subscribers at a certain evolution stage, there will be *n (n - 1)* call opportunities, e.g. in the stage 1 with only 5 urban subscribers U1, ...U5 there will be 20 call opportunities thereby yielding potential revenues of 20 traffic units. Suppose a moderate expansion of the network in the stage 2 with the adding of just one subscriber in the rural area (R1), then the network was enlarged from 5 to 6 subscribers (20%).But in this case call opportunities would have grown up to 50% since this *one* additional subscriber has created 5 inbound and 5 outbound call opportunities from existing ones. Since this rural-urban traffic has been supposedly rated as of short distance at 1.5 units per call, the expected revenues became 75 % higher (Fig.2),always under the assumption of equally-distributed call opportunities. An enlargement somewhat greater of the network (40%) has been accomplished at stage 3 where two rural subscribers (R1 and R2, Fig.3) created 22 new call opportunities, 20 of which rural-urban rated as short distance traffic, and 2 rural-rural rated as local (R1 to R2 and vice versa)(Fig.5) thereby increasing them by 110% respect to stage 1.Then revenue opportunities became 160% higher,even under our conservative assumptions



STAGE 2 Fig. 2

Note that a network with *n* subscribers will have *n(n-1)* call opportunities and tat the *nth* additional subscriber adds *2(n-1)* new opportunities, as depicted in the logarithmic scale of Fig.4. Short distance rates in this example take into account the con of "communities of interest" considered by Hudson(4) by adopting any intermediate value (+150% above local traffic) in order to fill any higher marginal cost of connections *U1...U5* with *R1, R2* by using state-of-the art transmission technologies. Nevertheless,tariffs nowadays can considerably differ in terms of distance-transmission responsiveness.In Argentina,where a rate rebalancing process has been accomplished,short distance daytime calls (30 to 110 Km) cost 10.9 times more than urban calls,though.

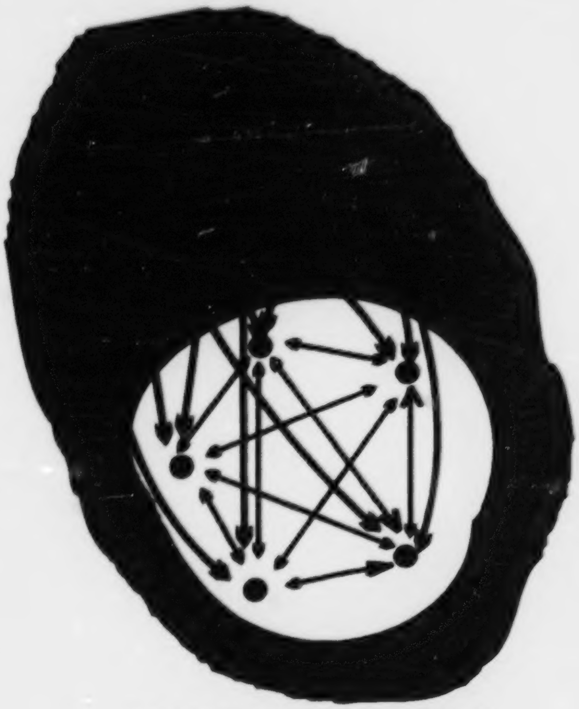
It has to be noted that there are economic factors encouraging the provision of service to rural customers even beyond this assessment, as occurred with the differences in their foreseeable consumption behavior. The relative lack of alternative communications media in rural areas in relation to urban ones might spur substitution effects tending to increase the average traffic per rural subscriber (in both inbound and outbound directions). Comparative studies performed by GTR-UNNE in last years in northern Argentina have shown outbound traffic consumption per subscriber in small towns 300% to 400% above the values of the main cities of the region -although tending to decrease after performed the rate rebalancing in 1997. In the stage 3 of the hypotetic network expansion another effect is the apparition of local, rural-rural traffic (R1-R2), of course depending on the relative size of the set of new customers incorporated. It is precisely from this point that we could perceive the massive expansion option as the best way to create a seed local traffic within rural customers. It is important to devise a way to introduce and further develop this rural-rural traffic as a part of the community consumption behavior.Normal marketing policies pursued by cooperatives and small rural operators use to initially eliminate or substantially reduce rural-rural rates.In our example,this traffic seems as too little compared with the rural-urban one because we have considerate just 2 subscribers and because they were added in two stages (one by one). A better way to meet this goal is a "sharp" expansion towards the rural area leading to immediately create local traffic habits among rural neighboring customers. The local traffic is very important for business rural subscribers, farming cooperatives and other communities of interest relying in the phone service as a way to conserve and strengthen their community ties, local entrepreneurship and social cohesion. This has to be seen as a regulatory matter and also as an "uneconomic benefit" derived from Unrestricted Expansion policies.However, local rural traffic has also engineering and economic implications e.g. the smoothing of seasonal traffic fluctuations, typical of farming activities like seed & harvest work.

Therefore, from the side of economic benefits including generation of marginal revenues, significant arguments support an Unrestricted Expansion policy. Concerning the marginal cost of such expansion, as long as plans were based in economies of scale and scope, right technologies and a reasonable operating efficiency in the operator, there are no reasons to significantly differ from marginal costs in the nearest urban area. Indeed, meeting demand from rural areas at lower availability levels (public service basis) like many countries in the developing world could be feasible and commercially viable. Since the early 1980 experiences of Mexico and Brazil (11) among others it has been demonstrated that rural telephony attracted private investment, even on a limited-competition environment . Last years in areas with extremely low telephone densities, public payphones and franchised telecom shops have been enabling telephone access to non-subscribers on a cost-affordable way. Indonesia (17,508 islands) with 120 million people, 70% living in rural areas and a whole density of 1.3 lin/100inh.boasts a strong growth in the number of telecom shops -averaging 30 % yearly, reported two years after the WDTC in 1994.(17) There are more than 1,500 shops generating an aggregate gross revenue of 60M(Pradham&Smith 1996)(18).

Just in another layer of the same reality, experiences with rural information networks like CALM in Australia (Computer Aided Livestock Marketing service)(20) showed that even on a residential basis, rural needs are far beyond the plain telephone line and rather requiring access to more advanced resources:databases,intranets and on-line services, often private-operated.

8. Competition and Subsidies in Rural Networks

Structural reforms with deregulation and liberalization processes led to different degrees of competition in urban areas: value-added services, data transmission, cellular telephony and satellite links among others. Wireless local loop and personal communications



STAGE 3 Fig. 3

systems (PCS) have been envisaged to provide a sort of bypass to hot unsatisfied demand and massive backlog affecting most networks in developing countries. Although large expansion plans in Latin America and the Pacific Rim have mobilized huge investments in local and long distance networks, cellular, satellite and fiber optics projects, local rural markets did not share a significant portion of them. In Argentina, despite deregulation initiatives benefiting the provision of basic service in rural unserved areas like Res.406/SC /93 there were just little effect in the number of new lines installed. This came from different reasons; overall, influencing factors did not properly match one each other at the best moments of the privatization process. The available technologies, the investment priorities and the regulatory framework did not agree themselves to the necessary degree leading to sound jumps in the rural network expansion.It is interesting to examine whether liberalization processes may strengthen or weaken the expansion of the network to rural areas and the Universal Service as a long-term goal. Among many studies, we just bring again into the EU report (5) which assessed the cost of the Universal Service Obligation (USO) for EU operators ranging between 1% of domestic retail call revenues for U.K. to 6% for Greece (country with the most dispersed settlement pattern of EU scattered in over 2,000islands The conclusion is that USO can be expected to fall with the onset of competition,due technology change,scope economies for selling valueadded services to otherwise uneconomic customers.Increasing efficiency of the incumbent operator under competitive pressures,which subsequently lower its general costs and turning on more customers, formerly considered as unfeasible.

Related to subsidy policies,as said by Melody(16) there was a curious change of mind in some instances affecting incumbent operators which, having initially assessed rural areas in their service zones as uneconomical to bring service, and consequently requiring major subsidies to do so, at the moment they were asked by the regulatory body about the possibility of granting a license to a competitor in order to operate such areas, surprisingly they started thinking different, and the supposedly uneconomic customers became economical without any kind of subsidy. This was the case of the last period of the former state-owned PTT of Argentina (*ENTel)* when the granting of POTS licenses to many small cooperatives between 1988 and 1991 led to the deregulation of the local service in unserved or manually-served areas (Decree Nr. 1742/88) (11). Nevertheless, there are a few successful experiences in the application of explicit subsidies to bring service to rural areas, as in the case of Chile,where it was decided to award subsidies to private operators and investors wishing to operate POTS in 1,285 localities typically under 1,000 inhabitants by means of a competitive bidding process. The winners got their licenses on a minor-subsidy request basis with subsidies ranging from USD. 300 to USD 26,000 per locality served, all on a single up front allowance. These up front subsidies do not attempt to cover all the installation costs, but to act as a seed fund (total about USD. 4.3 M.) to foster private investment in the rural network expansion (19).

9. Conclusion

Only the unrestricted expansion strategy has a true chance of success to provide sustainable services to rural areas. The rights of the rural population should practically reflect in long-term policies leading to a more equitable and balanced growth of the services, including appropriate rules tending to equalize local telephone densities and to narrow the urban/rural gap. The rural expansion should rely as far as possible in the use of common, market-standard, mass-produced equipment even when not originally devoted for rural applications (11). Technological policies should not discriminate against the application of ultimate, state-

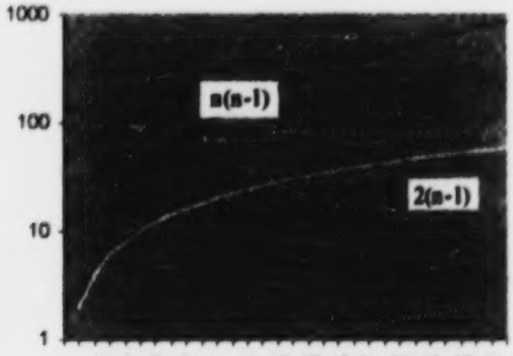


Fig.4

of-the-art equipment or advanced services in rural networks, even when not yet available in urban zones (LEOS and other alternatives). Technologies and services offered should take into account the greater dynamics of rural customers respect to the urban ones with frequent addings, discardings and movings. All these criteria are supposed to be integrated into a long run Strategic Model for the rural network which should include an Expansion model, an Operations model as well as an Insertion model. The most practical way to introduce these new criteria are the Pilot Area projects, like the Community Teleservice Centers (CTSC) in the same sense that ITU-BDT recommendations of WTDC-94 Conference encouraged them as a key part of the Integrated Rural Development Program of the Buenos Aires Action Plan (BAAP) (2).

10. References

1. *HCD-Argentina, Comision de Comunicaciones* (National Parliament) *Declaration, O.D. No. 414/94.* Buenos Aires, 8/1994.
2. ITU-BDT:"*Buenos Aires Action Plan-Documents WTDC-94/DT-2, DT-2/Rev.1 and DT-2/Rev.2 and Final Draft.* I World Telecommunications Development Conference.Buenos Aires, 3/1994.-
3. ITU-UNESCO:"*The right to communicate.At what price?*"Ibid. Document 94/4-E.Buenos Aires,3/1994.
4. Hudson, Heather E.:"*Converging Technologies and Changing Realities: Universal Service in the Information Age*"Proc.17th.Pacific Telecommunications Conference(PTC-95). Honolulu, USA 1/1995.
5. NEXUS Europe/ CURDS-Univ.of Newcastle,U.K./CCS -Odense Univ,Denmark et al.: "*An assessment of the Social and Economic Cohesion Aspects of the Development of the Information Society in Europe Vol.5- Synthesis and Recommendations(Final Report)* CCS-Odense University, Denmark.January, 1996.
6. NTIA-National Telecommunications and Information Adm. "*Survey of rural information infra-structure technologies*".Special Publication 95-33.USA,1995.
7. Goussal, D.M.:"*New trends in rural network strategic planning criteria*- IV European Regional Conference International Telecommunications Society (ITS). Stuttgart, Germany 9/1992.
8. Goussal, Dario M.: "*A Second Look to CTSC*". Proc. 18th.Annual Pacific Telecommunications Conference (PTC-96). Honolulu (USA), 1/ 1996.
9. Goussal, D.M.;Baez, L.M. and Balcewicz Konzen, E.: "*CTSC demand and underlying behavior: a case study in Brazil*".Proceedings, VIII ITS European Regional Conference. Vienna,Austria September,1996.
10. Goussal,D.M. and Balcewicz Konzen, Elizabeth T: "*A Synergetic Approach to Planning and Operating Community Telecentres*".Proc.15th. International Teletraffic Congress (ITC-15). Developing Countries Track. Washington, D.C. (USA) 6/1997.
11. Goussal, D.M.: "*Unrestricted Counterline Expansion in Large Rural Systems*". Proc. VI ITS European Regional Conference.Khania,Crete (Greece) 9/1994.
12. Preece, Robert:"*The role of Telecommunications in Economic Development and Income Distribution*". ITU- Forum 87. Vol 4. Geneve, 10/1987.
13. Ballesteros, J.P.: "*Telefonia en el Medio Rural*"Total Comunicaciones No.5, Buenos Aires 7/1994.
14. Lemay,Johanne and Yates, Robert: "*An investigation of technology convergence as an enabler in the local loop*". Proc.17th.Pacific Telecommunications Conference (PTC-95).Honolulu, USA 1/1995.
15. Goussal, D.M.: "*Local loop reconfiguration and rural service availability*". ibid.
16. Melody,W."*The overlooked opportunity: rural and remote area telecoms.* Pacific Telecommunications Review Vol.15, Nr.2. Honolulu, USA 12/1993.
17. ITU-BDT:"*Part 1-Assistance Program for the establishment of network planning capabilities in developing countries*"- Indonesia Submission. WTDC-94, Document 58-E. Buenos Aires, 3/1994.
18. Pradham,R.& Smith,Peter"*Franchising Telecom Service Shops-Meeting Demand from Non subscribers in Indonesia* Viewpoint, Note No.73. The World Bank. Washington DC., USA 3/1996.
19. Wellenius, Bjorn:"*Extending Telecommunications Service to Rural Areas-The Chilean Experience*". ibid. Note No.105. Washington DC. USA 2/1997.
20. Crellin, Ian R.:"*Developments in Data Networking for Rural Communities: a Future of Change and Challenge*". Converging Communities -OLTC Expert Group Meeting .Melbourne, Australia 1995."

Network Parameter		STAGE 1	STAGE 2	STAGE 3
N° Subscribers	Urban (U)	5	5	5
	Rural (R)	–	1	2
	Cumulative Expansion	–	**20%**	**40%**
Call Opportunities	Local	20	20	22
	Short Distance	–	10	20
	Cumulative Expansion	–	**50%**	**110%**
Traffic revenue Opportunities	*Local Units	20	20	22
	*Short D. Units	–	15	30
	Total	20	35	52
	Cumulative Increment	–	**75%**	**160%**

* Local calls supposed to be rated at 1 unit call. Short distance calls supposed at 1.5 unit call. Calls between R1 and R2 are supposed to be rated as local

Fig. 5

Promoting Local Competition in Colombia: Policy Challenges and Market Opportunities

Fabiola Montealegre

1. Abstract

Colombia followed a rather different approach to reform its local telecommunications market than the privatization model implemented in countries like Argentina, Chile, México and Venezuela. Implementation of a series of legal, regulatory and economic decisions have resulted in increased private sector participation, national and foreign, in the development of local telecommunications infrastructure, resulting in higher investment, network growth, lower cost per line, increased efficiency and responsiveness to user demands as well as more service choices. The introduction of wireless telecommunications technologies, now used by wireline and wireless carriers, have had significant impact in promoting competition in the local market. The paper examines the Colombian experience in the context of telecommunications reforms carried out by its neighboring Latin American countries.

2. Introduction

Before the 1990s, the state of Colombia's telecommunications sector development was similar to that observed in most Latin American countries and likely comparable to the state of telecommunications development in most of the developing world. Services were provided by publicly owned telecommunications companies which focused mainly on extending basic telephony services. Service supply was limited and unsatisfied demand was measured in long-waiting lists, which in Colombia used to be over 72 months. The pace of technology adoption was slow and quality of services was poor. Management practices of public operating companies were, in general, subject to political influences and Unions demands.

In the early 1990s a large number of developing countries, including Argentina, Chile, México and Venezuela, chose to privatize their telephone companies as the main force supporting telecommunications market reforms. The privatization model was defined to transfer a controlling interest to the private sector. In most Latin American privatization cases, there was at least one international winning consortium. Foreign partners brought into the country state-of-the-art technology and market expertise. The new company was granted limited monopoly for a fixed period of time, between 5 and 10 years, required to build capacity and prepare for the entry of competition. In exchange, governments obtained large sums of capital, used in most cases to balance the countries's external debt.

Colombia did not follow the regional trend to privatize its telephone companies, although there has been unsuccessful attempts aborted by strong Union oppositions. In 1992, Telecom Unions held a strike to protest a draft bill proposing the privatization of Telecom, Colombia's monopoly provider of national and long distance services. To ensure their voices were heard, Telecom Unions "*unplugged*" the company's national and international backbone network. Colombia was isolated from the international community for over 24 hours and so were the regions from the Capital city. In the last two years, Empresa de Teléfonos de Bogotá (ETB) Unions have held various strikes to protest draft pieces of legislation proposing the "capitalización" - private capital incorporation into the company's financial structure.

Colombia's approach to liberalize and promote private sector involvement in the telecommunications sector was rather different. The approach is not better or worse than the privatization model followed in other countries. However, evidence is mounting that Colombia's experience in attracting private sector participation in the local telephony market is having positive results, including higher investment, network growth, easier network access and lower cost per line, increased efficiency and responsiveness to user demands, as well as more service choices.

Increased competition in the local market has also contributed to speed up the long distance liberalization process which had been put on hold a number of times since it was first outlined in 1992. The largest local operating companies sought legal action against the telecommunications regulatory body (CRT), to force the opening of the long-distance market, in response to Telecom's aggressive plan to enter their local telephony markets. Telecom has continued developing its local telephony projects, but the local operating companies won the battle with the judges who ruled in favor of speeding up the liberalization of the long distance market.

In summary, this paper argues that the telecommunications sector reforms carried out in Colombia in the last five years have generated positive results in terms of promoting competition, encouraging private sector participation, strengthening network growth and increasing service choices. Reforms have also increased market opportunities for national and foreign investors, in all market segments.

3. Overview of Colombia's local telephone markets

In reforming the local telephony market, the Colombian government faced additional challenges of policy issues and market barriers compared with the situation of other Latin American countries before privatization occurred. One of the most relevant challenges was the structure of the local market comprised by a large number of publicly owned operating companies. There are currently 31 local operating companies, although the number of registered, but still not operating companies, is over 40.

In the cases of CTC/Chile; Entel/Argentina, Telmex/Mexico and Cantv/Venezuela there was primarily one company to be privatized. The privatization "deal" may have been more attractive to foreign investors when granted limited monopoly status and left with the task to modernize one company with national coverage. The breakdown of Colombia's telephone companies is presented in Table 1, indicating the number of cities and/or small towns they serve, as well as their teledensity as of December 1996: (See Table 1)

Local telephony services account for a large portion of total telecommunications sector revenue and investment in Colombia. In 1994, all telecommunications services generated US$1,450 million of revenues and 44% of them (US$635 million) were generated from the local telephone market. In 1995, out of a total of US$880 million invested in telecommunications, US$581 (66%) were invested in the local market segment.

Table 1

Operator	Towns	Density	Operator	Towns	Density
ETBogotá	3	28.77%	TelePalmira	2	12.64%
Telecom	728	N/A	Metrotel	1	4.45%
EPMedellín	17	27.61%	TeleNariño	1	8.82%
EMCali	3	22.52%	TeleSantamarta	1	4.43%
EPBucaramanga	3	24.86%	TeleUpar	1	8.77%
EMTBarranquilla	3	11.26%	EMCartago	1	11.66%
EPPereira	2	19.85%	TeleBuenaventura	1	6.38%
TeleCartagena	1	15.71%	EMBuga	1	9.22%
EPManizales	3	22.13%	ETGirardot	3	17.73%
TeleTolima	1	16.65%	TeleMaicao	1	6.41%
EDAntioquia	104	N/A	ERT	8	2.72%
TeleArmenia	1	22.27%	TeleCalarcá	1	11.40%
TeleHuila	2	14.80%	TeleCaquetá	1	4.41%
TeleTulua	6	16.14%	TeleSantarosa	1	10.84%
Emtel	1	13.92%	TeleObando	1	10.27%
TeleTequendama	1	1.27%			
			Total	904	12.69%

Source: Departamento Nacional de Planeación (DNP).**(1)**

Table 2

Services	Local	Cellular	ILD	NLD	Access Cellular	Access ILD	Access NLD	Others
Revenues	22%	12%	19%	20%	1%	13%	7%	6%

ILD: International long distance. NLD: National long distance.

Table 3

Services	Local	Cellular	LD	Television	Other
Investment	65%	19%	8%	2%	6%

Sources: DNP and The National Development Plan **(2)**

The revenue (1994 data) and investment (1995 data) breakdown of telecommunications services are shown in Table 2 and 3.

4. Increasing private sector involvement in telecommunications development

Instead of following the world privatization trend taking place within the neighboring countries, a number of legal, regulatory and economic decisions have been made to increase private sector involvement in financing infrastructure development and introducing new technologies and managerial practices between 1989 and 1996. In the context of this paper the various policies and strategies aimed at attracting national and foreign private capital become a comprehensive package of sectoral policies. However, there is no knowledge of an unified telecommunications policy supporting the decision to choose this "model" in order to achieve some of the results observed today.

4.1. Summary of the major legal changes

In 1989 Congress passed Law 72, which calls for the need to promote private sector participation in the development and modernization of the telecommunications sector. A year later, a newly enacted National Political Constitution outlined the legal grounds for changing the role of the State from that of the telecommunications service provider to the regulator and supervisor of telecommunications service provision. Subsequently, Law 42 of 1994, of *Servicios Públicos Domiciliarios*, mandated that public service operating companies had to change their ownership structure to allow private sector participation. Operators have the option of becoming state owned enterprises, forming joint-stock or mixed companies with private investors. Additional regulation has been enacted to allow public companies to form joint ventures with telecommunications suppliers to work on share-risk operations, which has been instrumental in the development of local competition in large markets like Bogotá and Cali.

A Telecommunications Regulatory Commission and a *Superintendencia de Servicios Públicos*
(Public Services Control Organ) were created to regulate and control, respectively, the development of fair competition, ensure service quality and coverage, and defend users rights. **(3)**

4.2. New entry

Legal and regulatory changes introduced since 1989 have resulted in the entry of new local telecommunication players in niche markets. The threat to competition has also been beneficial to incumbent local operating companies, forcing them to modernize and respond faster to market demands for service access and quality. The result has also been higher network growth rate. Law 42 removed barriers to enter the local telephony market and provided the opportunity for new companies to obtain 10-year renewable licences to operate local basic telephony and local extended telephony. The latter relates to telephone service provided within a region comprising several cities.

Telecom, the sole provider of national and long-distance service in Colombia, which has been also the service provider of local services in small towns and rural communities, obtained licenses and entered the large markets of Bogotá and Cali. Empresas Públicas de Medellín (EPM) plans to have its network operational in Bogotá during the first quarter

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of 1998. (4) Other new companies are already operating and rapidly gaining market share. Some of these are ERT in the state of Valle del Cauca, Metrotel in the city of Barranquilla, TeleTequendama en the resort area of Girardot, TeleFlorida in Florida and TeleYumbo in Yumbo, an industrial neighboring town of Cali.

The entry of new players in niche markets has significantly increased telephone density. In some markets just the threat of competition has been sufficient to speed up modernization plans and increase network growth. The participation of national and international private capital in the development of the new local telecommunications service infrastructure has been significantly important. A total of 1,684,738 new telephone lines will be installed by the year 2005, based on joint-ventures between local operating companies and international suppliers, as shown in the Table below: (See Table 4)

4.2.1. Network growth

On average, Colombia added 152,874 lines per year during the 1980-90 decade. Under the new regulatory and competitive environment developed from 1990 to 1995, the average number of lines added per year increased to 410,745 lines. Between 1995 and 1996 a total of 791,734 new lines were added, as shown in Table 5.

The Latin American privatization experience of telephone companies has been well reviewed by telecommunications experts with interest in the region (6). Modern networks have been built and expanded throughout concession areas, rapidly increasing market access. Telephone densities are growing faster than they were growing before privatization took place. There has been increased efficiency and service quality is higher. However, with the exception of Chile, subscribers in the Latin American countries have not yet enjoyed the benefits accrued from competition. This is because the privatization model followed in these countries involved granting limited monopolies or duopolies for a fixed period of time, based on the justifiable argument that new owners needed time to recover their investment and prepare for the entry of competition.

The following table compares network growth data on the four Latin American telephone companies privatized in the early 1990s: CTC, Chile; Telecom/Telefónica, Argentina; Telmex, México, and Cantv, Venezuela. The Table provides information about the privatization date, private capital generated from the sale (without including infrastructure investments) and the number of lines in service at the time of the sale. It is aimed at evaluating network growth per year. Data has not been readily available for every year in the four cases. However, the available data provides the basis to calculate the average number of lines increased per year since privatization occurred. (See Table 6)

There is no doubt that the privatization model followed in these four countries has been successful in increasing network growth. However, it is worth while pointing out that there are many ways to promote private sector involvement besides privatization. Network growth and modernization can also be accomplished by a combination of sectoral policies and strategies, especially when they are more suitable to the country's telecommunications market structure. The rapid growth rate accounted for in Colombia in the last 3 or 4 years, supports this argument.

Table 4

Operator	Joint-venture with	Number of lines	Project start date	Project end date
Telecom	Itochu	31,540	July 96	June 2003
	Consortia Siemens and Centelsa	86,350	July 94	May 2000
	Nissho Iwai Corporation	97,400	June 96	May 2002
	Unión Temporal Alcatel	65,800	July 96	April 2004
	Nortel CALA	36,700	July 96	Sep 2004
	Alcatel Bell Telephone	27,276	Augt 93	Dec 1999
	Nortel	308,046	Augt 93	Aug 2003
	Alcatel Standar Electric ASESA	192,126	Sep 93	June 2004
	Siemens	110,000	Dec 95	April 2001
	Ericsson	110,000	Dec 95	Aug 2001
	Nortel	220,000	Dec 95	April 2001
	Nissho Iwai Corporation	110,000	Dec 95	March 2002
Empresa Regional de Telecomunicaciones	Consortia Siemens and Etelsa	44,500	Sep 94	June 2004
Empresas Públicas de Medellín	Itochu Corporation	95,000	Feb 97	May 2005
TeleCartagena	Itochu Corporation	125,000	Nov 96	Jan 2002
TeleNariño	Unión Temporal Siemens and Pirelli	25,000	Jan 97	Jan 2003
Total		1,684,738		

Source: SuperCifras. Issue 1 published 1Q97 (5)

Table 5

Year	Lines installed	Number of lines increased	Percentage of lines increased per year
1986	2,135,633		
1987	2,270,076	134,443	6.3%
1988	2,381,651	111,575	4.92%
1989	2,630,414	248,763	10.44%
1990	2,851,021	220,607	8.39%
1991	3,071,628	220,607	7.74%
1992	3,374,143	302,515	9.85%
1993	3,839,545	465,402	13.79%
1994	4,281,027	441,482	11.5%

Year	Lines installed	Number of lines increased	Percentage of lines increased per year
1995	4,904,746	623,719	14.57%
1996	5,696,480	791,734	16.14%
	37,436,364	3,560,847	

Source: DNP Reports. **(1)**

Table 6

Operator	Date	Market structure	Competition introduced	Amount paid US$ ($Mil)	Lines at sale	Lines in 1995	Average number of lines increased per year
CTC / Chile	12/87	Private monopoly/now competitive	1995 (7 years)	293	581,000	1,754,060	146,632 (8 years)
Telmex/ Mexico	12/90	Private monopoly	1997 (7 years)	1,757	5,190,000	8,492,500	660,500 (5 years)
Telefónica/ Argentina	11/90	Private duopoly	2000 (10 years)	482	1,696,000	5,622,474	507,095 (5 years)
Telecom/ Argentina	11/90	Private duopoly		386	1,391,000		
Cantv/ Venezuela	12/91	Private monopoly	2000 (10 years)	1,900	1,600,000	2,564,500	241,125 (5 years)

Sources: ITU: Americas Telecommunications Indicators. May 1994 **(7)**. Companies Reports **(8)**. Pyramid Research newsletters **(9)**.

Table 7

ETBogotá	EPMedellín	EMCali	E.P.Bucaramanga	EMT.Barranquilla	Telecom (Over 800 communities)	The rest of the country
34.5%	14.92%	8.80%	3.21%	3.13%	17.13%	18.31%

Table 8

Teledensities	ETBogotá	EPMedellín	EMCali	E.P.Bucaramanga	EMT.Barranquilla
1989	15.86%	15.4%	10.82%	9.6%	5.8%
1996	28.77%	27.61%	22.52%	24.86%	5.0%

Source: DNP.

4.2.2. Increased teledensities

The 31 local telephony companies serve 904 municipalities, cities or towns. There was a total of 5.7 million of telephone lines installed and 4.6 lines in service, as of December 1996. The country's telephone density (installed lines) has increased from 8.22% in 1989 to15.56 % in 1996, but six operating companies concentrate 82% of telephone lines in service, as shown in the table 7 and 8.

Changes in ownership of public operating companies have also had positive results. The case of TelePalmira illustrates this point. TelePalmira was one of the first companies to change its ownership structure to allow private investors to take 51% stake of the company. TelePalmira has significantly replaced and expanded its network increasing its teledensity from 4.9% in 1989 to 12.6% in 1996. The Ten Year National Plan forecasts that TelePalmira will be one of the five operators with the highest telephone densities, 23%, in the year 2000, as shown in Table 9.

4. 3. Wireless telecommunications technologies are playing a key role

Colombia was one of the last Latin American countries to award cellular licences. However, the country's subscriber base is rapidly growing reaching 738,669 subscribers at the end of June 97, only after three years of commercial operation. The following chart compares subscriber growth of cellular service in Colombia with that of selected Latin American countries where cellular service was introduced 5 and 6 years ago: (See Table 10)

The rapid development of the cellular industry in Colombia has been explained by the following factors:

- The adoption of a regional duopoly market structure which has helped to promote fierce competition between the two operators disputing market share in each of the three concession regions. The country was divided into three regions:
  Eastern: Celumóvil and Comcel (16.4 inhabitants, includes the large markets of Bogotá, Bucaramanga, Ibague, Cúcuta and San Andres);
  Western: Cocelco and Occel (13.5 inhabitants, includes the cities of Cali, Medellín, Armenia, Pererira, Manizalez, Popayán, Pasto and Quibdó), and
  North Coast: Celcaribe and Celumóvil Costa (7.2 ihabitants, includes Barranquilla, Santa Marta, Cartagena, Valledupar, Montería, Sincelejo and Riohacha).
- The Government decision to limit market exclusivity to five years and the expectations raised around the entry of new wireless services operators: SMR-radio trucking (1997), PCS (1999) and GMPCS (1998).
- The ownership structure which allowed high national and international private sector capital and management. The significant participation of foreign know-how, expertise and capital has been a key factor: Comcel (BellCanada International); Celumóvil (A.T.T.Wireless); Occel (Cable and Wireless); Cocelco (Telefónica International/CTC Chile) and Celcaribe (Millicom International).
- The conditions included in concession contracts to reach specific targets for service coverage, quality, digitization schedules and customer service controls. All six operators cut over AMPS/D-AMPS/TDMA networks. The rate of TDMA deployment has

Table 9

Lines in 1989	Density 1989	Lines in 1995	Density 1995	Lines in 1996	Density 1996	Lines in 2000	Density projected by 2000
13,651	4.9%	22,502	8.8%	30,085	12.6%	80,000	23%

Source: Plan Nacional de Telecomunicaciones.**(10)**

Table 10

	México	Argentina	Chile	Venezuela	Colombia
Start date	10/89	11/89	3/91	11/91	3/94
Subscribers March	1,119,000	849,265	339,445	656,700	584,801
Subscribers added per year	159,857	121,323	56,574	109,450	194,934

Sources: Primary research based on interviews with operators and review of secondary sources.

Table 11

Date	Frequency band	Operators	Suppliers
12/94	897,5-905,0 908,0-915.0 942,5-950,0 953,0-960,0	EDAntioquía, Telecom, Emtelsa. EPMedellín, EMCali, TeleCartagena, TeleArmenia	Motorola, Ericsson
4/95	1,427-1,525 2,300-2,500 3,400-3,700	Telecom,	NEC, TRJ, Nortel, NEC
9/96	343,050-345,150 357.050-359,150 380,025-382-000 390,025-392.000		
12/96	1910-1930	Tekecom, Emcali, ETBogotá	Ericsson, Siemens, NEC

Source: Ministry of Communications and primary research. **(12).**

6. References

(1) Departamento Nacional de Planeación (DNP). Telefonía Local a nivel nacional. Issues published in 1989, 1992, 1993, 1995, 1996. Colombia

(2) Ramirez, Gustavo. (1996). Competencia en Telefonía Local en Colombia. Revista Colombiana de Telecomunicaciones (pp12-18, Vol 3 No. 9). Colombia: CINTEL.

(3) Compilation of Laws and Regulatory decisions published by Congress, Ministry of Communications, Regulatory Commission.

(4) Ministry of Communications decree laws.

(5) Superintendencia de Servicios Públicos. SuperCifras. Issue 1 published 1Q97. Colombia

(6) There are a number of articles written on this subject. A recent compilation of papers reviewing the lessons learned from the Latin American privatization experience is

been rather high in all six cases.

- The adoption of the calling party pays tariff system since the beginning of service operation has played a key role in subscriber base growth.

As cellular service enters the third concession year, operators are changing their marketing approach to target the mass market. The emphasis of their extensive media advertising campaigns is on portraying cellular service as "the tool to increase business productivity". They are aiming to reach informal workers, professionals at all levels, young students, taxi drivers, messengers, etc. Innovative media campaigns developed in joint marketing ventures with computer stores, fast food chains, retail stores, newspapers and the banking sector, are designed to join new subscribers while they buy a set of tires, a PC, a one-year newspaper subscription. Operators have offered free digital handsets with zero network setup charges in these new marketing ventures.

The point to be emphasized is that cellular service has been portrayed as a substitute for wireline communications for specific type of users. It has also provided rapid market access in urban and rural areas where basic service is still not available. Contrasting with other Latin American countries where cellular service is still perceived as a luxurious service, operators in Colombia are developing new marketing strategies to promote it as "a basic need". **(11)**

4.4. Availability of spectrum for new technologies

Additional spectrum bands have been opened for incumbent and new telephone operators willing to use radio technologies to rapidly provide fixed wireless access to new subscribers. The following bands were opened and licenses have been already awarded to a number of operators: (See Table 11)

Special attention is given to the important role wireless telecommunications technologies have played in improving access to telephone services, since cellular service has and continues to be used as a substitute to wireline communications for many user groups. The significant growth of subscriber base has also been instrumental to help increase local market dynamics.

5. Local competition is speeding up the long-distance liberalization process

Increased competition in the local market has also contributed to speed up the long distance liberalization process which had been put on hold a number of times between 1994 and 1997. The regulatory framework defined in Law 42, to promote competition in the local telephony market, has not had the same impact on encouraging competition in the long-distance market. A number of approaches have been proposed to support the liberalization of the long-distance market. At first, a "triopoli" (three players) model was suggested, Telecom and two new operators. Later, it was proposed that the largest local operating companies could join into one company and become the fourth competitor; therefore, the market would have been shared by 4 players. There have also been advocates of free competition, following the Chilean multicarrier experience.

During 1996 and 1997, there were long political and regulatory debates with the participation of Congress, the Ministry of Communications, the Regulatory

Commission, the operators and the Unions, seeking agreement on the best suitable framework to rule the liberalization of the long-distance market. On August 1996, the present administration of Ernesto Samper (1994-98) negotiated an agreement with Telecom Unions which slowed down the liberalization process and introduced new conditions to the process. These were basically summarized in carrying out new studies to demonstrate the viability of the process.

While all interested players took part of the debates, Telecom, the key player in the game, decided to aggressively implement its local telephony expansion projects in the largest and more profitable markets of the country. The reasoning behind Telecom's strategy was the need to decrease its dependence on long distance and international revenues and diversify its service portfolio. As indicated in previous sections of this paper, Telecom signed a number of joint-venture agreements with international suppliers and started rapidly to deploy modern local networks in Bogotá, and most recently in Cali.

During 1997, the largest local operating companies sought legal action against the telecommunications regulatory body (CRT), to force the opening of the long-distance market, in response to Telecom's aggressive plan to enter their local telephony markets. Although Telecom continued developing its local telephony projects, the local operating companies won the battle with the judges who ruled in favor of speeding up the liberalization of the long distance market.

On 31 August this year, the CRT made public the rules now governing the liberalization of the long-distance market. The key elements of Resolución 86 are below outlined:

- The long distance market will be opened to free competition. There are no limits to the number of market players.
- Licenses will be awarded to Empresas de Servicios Públicos, providing specific criteria is met.
- 10-year licenses will be awarded by the Ministry of Communications..
- There are no limits of foreign investment ownership participation in consortia formed.
- The consortium must be formed by at least one Colombian local telephony operator, with a minimum of 150,000 lines in service as of December 96 and one company with experience in international long distance services which handled at least 400 million minutes of international traffic in 1996.
- Colombian operating companies partners in a consortium, can not concentrate more than 35% of the telephone lines in service in Colombia at the time the license is requested.
- Interested consortia must pay a US$150 million licence fee to the Fondo de Telefonía Social (Social Telephony Fund).
- Licensed companies must pay 5% of annual revenues to the Social Telephony Fund.

At press time, no bids had been submitted to the Ministry of Communications.

6. Conclusions

- **Private sector involvement.** Evidence is mounting that Colombia's "model" to encourage private sector participation in the development of local markets infrastructure and services has been greatly beneficial, to rapidly deploy infrastructure, inject capital, transfer technology, introduce market forces and provide operational expertise.

- **New entry**. New entry and the threat of competition in the local market played a key role in increasing network and market growth in Colombia. The incentives created by the new telecommunications legal and regulatory structure and the emergence of new technologies might favor the creation of new local companies, even in markets where incumbent companies are making huge efforts to fulfill unsatisfied demand and improve service quality. However, it is feasible that towards the year 2005, some of these companies will merge and that some of them will disappear, due to financial and technological reasons and in accordance with universal capital concentration trends.

- **Availability of spectrum**. The decision to open new frequency bands for radio-based technologies used in the local loop has been critical to speed up the deployment of networks in niche markets. Wireless telecommunications have proven to be a potential force in improving telephone densities and promote competition.

- **Strategic alliances**. The accelerated pace of technology development and adoption observed around the world, both in switching and transmission technologies, might make it difficult for small and medium sized companies to rapidly adopt, assimilate and adapt new technologies. Therefore, strategic alliances among the 30 operators are starting to developed.

- **Regulatory challenges**. There are still regulatory and political barriers to overcome to ensure a "level playing field" in the local markets, since there is no tradition of telecommunications regulation in Colombia. The Telecommunications Regulatory Commission and the Superintendencia de Servicios Públicos are playing a key role in defining the rules of the game and supervising the rules are followed. However, there is still a long road to create a true competitive local telecommunications market environment.

Satellite / Wireless Communications In Global Information Infrastructures

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ABSTRACT

A huge potential exists for satellite/wireless communications in global information infrastructures. Both developing and developed Countries (to some extent) will likely have in the next future important geographical nodes connected via wireline/satellite links, whereas wireless/cellular "leopard" spots may complement wireline networks to service (part or the whole of) the remaining areas. A very effective way to penetrate this market is to exploit wireline **and** satellite/wireless technologies **together**. The Paper will focus on the advantages and issues raised through deployment of global satellite networks linked with national wireline systems, showing how market, regulatory and geo-political aspects keep pace with technological - and financing - breakthroughs necessary to implement and deploy the systems.

1. THE ROLE OF SATELLITES IN PERSONAL COMMUNICATIONS

Satellite communications can effectively complement terrestrial networks wherever the latter are either not competitive (low traffic density), not applicable (maritime and aeronautical services) or less/not developed at all. In the "personal" communication networks/services (PCN/PCS) area, satellites can play indeed a crucial role in a *global* scenario. Satellite PCS (S-PCS) - also known as global mobile personal communications via satellite (GMPCS) - refer to satellite systems, mostly in non-GEO orbits (NGSO), that permit telephone transmissions via wireless handsets to reach destinations anywhere on Earth. The mature technologies of geostationary earth orbit (GEO) satellites can be effectively utilized for setting up S-PCS. However, for such applications, other orbital configurations - low/medium earth orbit (LEO/MEO) constellations - are being considered as more effective for the provision of PCS to hand-held terminals. Differently from GEO satellites, LEO spacecraft only fly across the service area for some tens of minutes a few times a day (depending upon the orbital parameters), so that a real-time service is not allowed unless a complete constellation of LEOs (from about 10 to as many as several hundred) is operational, in such a way to have at least one satellite in visibility for 100 % of the time [1][2]. Conversely, the lower altitude (typically from 700 km upwards as opposed to 36,000 km GEO) permits more effective communication performances with smaller/low power user terminals, due to substantially lower link attenuation (15-to-20 dB depending upon the orbit).

2. TECHNICAL / GEO-POLITICAL ISSUES WITH GLOBAL SATELLITE NETWORKS

The inherent "global" features of satellite constellations pose several issues to be solved at worldwide level -- the most important are listed underneath [3]. Indeed, international consensus - substantially reached via industrial cooperation among the involved World Regions - is needed to solve the relevant regulatory and geo-political issues associated with *global* communications.

- By-Pass/National Sovereignty. National Administrations are concerned that global satellite networks will drain calls (i.e. revenues) from their national networks. Such concern may be mitigated by properly tailoring the tariff structure, ensuring fair revenue allocation to national Network Operators.
- Market Access. Developing countries are concerned that the bulk of their citizens may not be able to afford global satellite networks. Lower rates/"most favored nation" conditions should be set wherever possible for such Countries.
- Safety and Distress Operations. Global satellite networks should be an essential element in disaster relief.
- Call Monitoring / Legal Call Intercept. Proper inter-governmental agreements are needed to agree upon common standards and effective Agencies co-operation.
- Country Code. One aspect of sovereignty that global satellite networks operators are trying to

achieve is each system having its own country code, so in essence each global satellite networks would be a "virtual country".

- Equipment Type Approval, Free Circulation and Use. Crucial requirement for true *global* operation, allowing users to freely "roam" all over the World with their handsets.
- Interworking with Terrestrial Systems / Cellular Interprotocol Roaming. Very important not only for mitigating bypass concerns, but also for seamless interconnection/roaming with terrestrial wireless systems, substantially enlarging the customer base.
- Network Management on a Global Basis. Each and every Country should co-operate to this end.
- Management of Routing Information. Home/visitor location registers (HLR/VLR), switch initialization in every ground access point, ... Important security aspects are involved, as well as need for agreements for traffic back-up re-routing in case of emergency.
- Business Support System. Dedicated, critical software structure taking care of billing and settlement policies among Network Operators, Regional Operators and Service Providers. Generally a commercial issue, although sovereignty policies are involved for what concerns operating licenses in each Country.

3. MARKET FOR TELECOMMUNICATION SERVICES

Overall, the (telecommunication) global satellite services industry is projected to grow (Table 1) from around US$14B in 1995 (about 2.5% of the overall telecom market) to more than $37B in the year 2000 (almost 5% of the market). Commercial global mobile personal communications via satellite (GMPCS) revenues are forecasted to increase from around $800M in 1995 (6% of Satellite revenues and 0.15% of total telecom market) to $9B in 2000 (about 25% of Satellite systems revenues and 1.2% of the total market globally). In the next decade, GMPCS subscribers (Fig.1) are forecasted to pass from the original 2-3 million of the year 2000 (1% of the total wireless market) to more than 10 million in 2005 and 20 million in 2010 (about 2% of the market). This "niche" market is mostly addressed by the large capacity, worldwide "big" LEO systems operating at L/S band - Aries, Ellipso, Globalstar, ICO-P, Iridium, Odyssey (Table 2) - and offering a full range of telephony-based services (including voice, data and facsimile), but also by "little" LEOs below 1 GHz - Gonets, Leosat, Orbcomm, Starsys, Vitasat, ...-, substantially used for store-and-forward/messaging purposes (e.g. utility meter reading, environmental monitoring, data collection and distribution, fleet management,...) [1][2][3]. Furthermore, presently proposed global satellite networks like the 288-(formerly 840-)spacecraft *Teledesic* (McCaw/Gates), the 48-spacecraft Alcatel *Skybridge* (formerly *Sativod*), the 63-satellite Motorola *Celestri* as well as the many Ka-band FCC filings of September 29, 1995 (*Astrolink, Cyberstar, Millennium, Spaceway, Voicespan, ...*)[4], promote satellite technologies to provide 20/30 GHz broadband/interactive multimedia services to developing and developed countries, paving the road for global information infrastructure (Tables 3 and 4).

In the mobile services area, the *cellular* market is growing up at an enormous rate. The cellular phones throughout the world were 7.8 million in April 1990, 50 million in 1994, 115 million in 1996, 170 million in 1997. Only across Europe 6 million cellular users were present in February 1993, 14.2 million in 1994, 30 million in 1996, 48 million in 1997. The digital global system for mobile communications (GSM), introduced in 1992, had in Europe 1.1 million subscribers at the end of 1993, 4.2 million in 1994, 27 million in 1997 (55 million worldwide).

Recent forecasts of worldwide cellular market indicate that America alone - mostly represented by USA - will pass from the 1993 17 million subscribers to more than 120 million in the year 2002; Europe (8.5 million in 1993) will account for another 130 million, whereas Asia-Pacific Region is estimated to boom from the 1993 6.5 million to more than 200 million in 2002. Rest of the World (RoW) subscribers will sum up to about 50 million. Worldwide, the 34 million subscribers of 1993 will likely exceed 500 million by 2002, with a yearly compound growth rate of almost 60% over the ten-year period.

4. SATELLITE SYSTEMS AS A COMPLEMENT OF WIRELESS NETWORKS

Despite the very significant, worldwide growth of wireless telecommunication systems in recent years, still substantial limitations prevent to communicate anywhere at any time. As a matter of fact, terrestrial wireless systems only cover a small portion of the Globe. More than 3 billion individuals worldwide are presently either based or operating outside terrestrial wireless coverage. Even considering a *nominal* penetration rate of 1/1000, a potential market of more than 4 million customers can be expected on a worldwide basis by the year 2002.

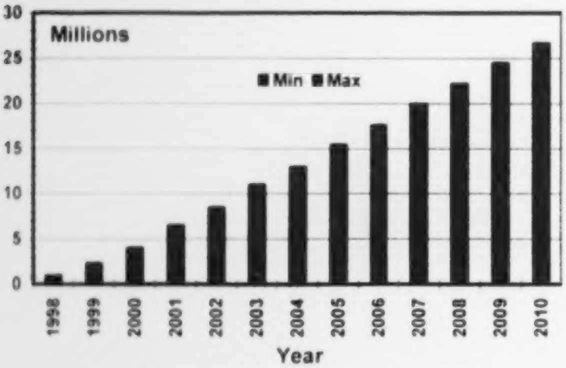

FIG.1. GMPCS SUBSCRIBERS.

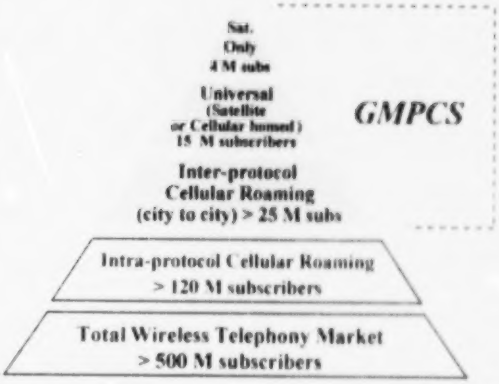
Sat.
Only
4 M subs
Universal
(Satellite
or Cellular homed)
15 M subscribers
Inter-protocol
Cellular Roaming
(city to city) > 25 M subs
GMPCS
Intra-protocol Cellular Roaming
> 120 M subscribers
Total Wireless Telephony Market
> 500 M subscribers

FIG.2. WORLDWIDE WIRELESS MARKET (2002).

Furthermore, wireless terrestrial systems are based on many different technical standards, making impossible for subscribers to use their handset when moving out of their *home* public land mobile network (PLMN) across *non-compatible* PLMNs. In addition, even having a different, *compatible* handset available, it is not possible (with limited exceptions) for them to be served by (or to "roam" onto) the host network maintaining their phone number and billing from home service provider. Such a *anybody, anywhere, any time* concept associated to *single number* and *single bill* features would be very hard without a centralized roaming entity owning a *global backbone* network -- with associated "clearing house". At least 25 million individuals would be interested in such a "inter-protocol" roaming by 2002.

Global mobile personal communications via satellite (GMPCS) can meet the above needs. They can provide mobile telecommunication services to users across areas uncovered by alternative means (*primary* services), as well as customers traveling around the world (*supplementary* services). In both cases, GMPCS do ***not*** compete with terrestrial wireless services; they rather complement (cellular) networks so as to *increase the value* of the aggregate service to the customer *on a global basis*.

The GMPCS *ground network* is composed of a number of gateway earth stations (GES), each serving a specific geographic area. Each GES has basically to: (i) interconnect the constellation with PSTNs of the served Countries (in order to allow establishing communication links between the satellite constellation and every fixed/mobile network operating in the territory of origin/destination); (ii) provide all the administrative functions related to customers *registered* in the territory of competence ("*home subscribers*") and/or to provide the connection functions related to the service delivery for customers located in other territories ("*visiting subscribers*"). Interconnection with PSTN is generally provided by direct links to one or more international switching centers (ISC) of the relevant networks.

One relevant capability of GMPCS, owing to its *global backbone* feature, is to easily perform *cross-protocol terrestrial wireless roaming*. In other words, it is easier than with terrestrial means to perform protocol translation functions between networks based on different technical standards (e.g. U.S. IS-41 and MAP in the GSM world). The satellite network - through its GESs - and terrestrial cellular networks in roaming partnership may be interconnected one each other by means of signaling links exchanging information for user mobility management.

As a consequence of what discussed above, GMPCS can address different market segments. As already pointed out, the worldwide wireless telephony market is estimated well in excess of 500 million subscribers by the year 2002 (Fig.2). Among them, subscribers usually roaming across areas served by *compatible* systems (utilizing the same standard) can satisfy their telecommunication needs by means of the standard roaming agreements between network operators (*intra-protocol* roaming, e.g. GSM in Europe -- and part of remaining World). This market segment will likely account for 120-150 million users in 2002. However, another (smaller) segment made of some 25 million users will need to roam between *non-compatible* networks -- *inter-protocol* roaming. In this case, GMPCS can provide all protocol translation functions allowing the home and host networks to exchange appropriate signaling information. This enables customers to be served by the host network while keeping the *same number* and the *same bill*. At present, a large number of cellular networks based on different standards are operating around the world; however, a major portion of the market is constituted by networks based on two main techniques : IS-41 (AMPS, CDMA, TDMA), substantially used in the Americas, and GSM (GSM 900, DCS 1800, PCS 1900), developed and used in Europe and in the process of penetrating several other Regions in the World.

Inter-protocol services meet the needs of cellular customers roaming to areas already covered by terrestrial systems (even with different standards), but do not solve the problems of customers who have to move all over the World (including uncovered areas). This category of "universal" customers (15 million by the year 2002) will likely make extensive use of GMPCS constellations. Each user may choose to be a customer of either GMPCS (*universal satellite homed*) or any other cellular network (*universal cellular homed*). Users based in a geographic area well served by cellular and rarely moving to uncovered areas will likely choose to be homed on cellular and roam onto GMPCS when necessary. On the contrary, users frequently traveling to uncovered areas or based in geographic areas poorly served by cellular may find it convenient to be homed on GMPCS and roam onto cellular wherever possible.

Last but not least, some 4 million users, substantially based in Countries lacking good telecommunication infrastructures and with no or little need to move abroad, may choose to use the GMPCS constellations only (*satellite only*), often representing the only telecommunications alternative.

In total, the addressable market for GMPCS is going to be about 45 million customers in 2002, i.e. roughly 10 percent of the worldwide wireless customer base.

5. REGIONAL SATELLITE SYSTEMS ("SUPER" GEOs) IN ASIA-PACIFIC REGION

The *Asian Cellular Satellite (ACeS)* has proposed a $740 million GEO satellite covering Asia, including India, China and Australia, and offering mobile voice and data telecommunications to briefcase sized mobile terminals and car mounted units. ACeS is owned by P.T. Pasifik Satellite Nusantara of Indonesia, the Philippines Long Distance Telephone Co. and Jasmine International of Thailand. Satellite launch is now scheduled for the first quarter of 1999, and turnkey system delivery by second quarter of 1999. ACeS signed an agreement with Lockheed Martin Corporation to build and operate the satellite.

The *Asian Pacific Mobile Satellite (APMS)* has proposed a $900 million, four satellite system called "Garuda", covering India, China and Asian nations, offering mobile telecommunications from portable terminals

Afro-Asian Satellite Communications (ASC) has proposed a two satellite system offering mobile telecommunication services to 55 countries in the Middle East, Asia-Pacific and eventually Africa. ASC has announced that their system will serve dual mode, cellular satellite hand-held terminals. The system is scheduled for launch in 1998/1999. Total cost of the system is expected to reach $800-$900 million.

Optus launched in 1994 a GEO satellite covering Australia, New Zealand and parts of the Pacific Basin. The satellite provides mobile and fixed, voice and data services, to briefcase sized mobile terminals and car mounted units. Optus is owned by Bell South, Cable and Wireless and an Australian investment group.

6. CONCLUSIONS

As a general conclusion satellite communications, associated to wireless technologies, may play a major role in global communication infrastructures.
The related market is rather attractive, and proper technology integration may drastically increase the value of the service to the end user. However, crucial issues have to be addressed to make GMPCS up and running. To this end, it is of primary importance to bear in mind that, in addition to technological challenges, service, market, financing and regulatory aspects are indeed key issues to consider when designing, implementing and deploying such global communication infrastructures. Satellite/wireless communications, with appropriate provisions for mitigation of relevant technical/geo-political issues, can be the "glue" for effectively keeping all this together, not competing with, but rather complementing, wireline technologies to better serve the Customers.

REFERENCES

1. F.Ananasso, F.Delli Priscoli: "The Role of Satellites in Personal Communication Services", *IEEE Journal of Selected Areas in Communications (JSAC)*, Special Issue on Mobile Satellite Communications for Seamless PCS, February 1995
2. F.Ananasso: "Satellite and Personal Communication Services: Market, Spectrum and Regulatory Aspects", *AIAA 16th International Communications Satellite Systems Conference*, Washington, D.C., February 1996
3. F. Ananasso: "Satellites and Information Super-Highways: Quickly Deploying Global Communication Infrastructures", *Pacific Telecommunications Review*, December 1996
4. Federal Communications Commission (FCC) Filings for Ka band satellite systems, 29 September 1995
5. Federal Communications Commission (FCC) Filings for mobile satellite systems, 26 September 1997

TABLE 1. WORLDWIDE TELECOMMUNICATION SERVICES REVENUES.

YEAR	1995			2000		
REVENUES	$ Billions	% of Total	% of Subtotal	$ Billions	% of Total	% of Subtotal
TOTAL	***550***	***100.0%***	***N/A***	***775***	***100.0%***	***N/A***
LONG DISTANCE	200	36.4%	N/A	300	38.7%	N/A
INTERNATIONAL	58	10.5%	N/A	100	12.9%	N/A
SATELLITE COMMUNICATIONS PORTION OF THE ABOVE						
SUBTOTAL	***14***	***2.55%***	***100.0%***	***37***	***4.77%***	***100.0%***
DTH/DBS Video	7.7	1.40%	55.0%	18.5	2.39%	50.0%
Other Video	3	0.55%	21.4%	3.8	0.49%	10.3%
Data	1.3	0.24%	9.3%	4.2	0.54%	11.4%
Voice	1.2	0.22%	8.6%	1.5	0.19%	4.1%
Mobile (MSS)	0.8	0.15%	5.7%	9	1.16%	24.3%

TABLE 2. "BIG" LEO SYSTEMS.

SYSTEM	ORBIT ALTITUDE (km)	INCLI-NATION	PERIOD (minutes)	ORBITAL PLANES	SAT's/ PLANE	TOTAL # SAT's
ARIES	Circular (1018)	90°	105.5	4	12	48
TELEDESIC	Circular (700)	98.2°	98.77	21	40	288
ELLIPSO BOREALIS	Elliptic (520/7800)	116.5°	180	3	5	15
ELLIPSO CONCORDIA	Circular (7800)	0°	280	1	9	9
GLOBALSTAR	Circular (1389)	47°52°	113.53	8/8	3/6	24/48
ICO	Circular (10500)	55°	360	3	4	12
ODYSSEY	Circular (10373)	55°	359.53	3	4	12
IRIDIUM	Circular (780)	86.4°	100.13	6	11	66

SYSTEM	FREQUENCY		SERVICE		COST (US $ Million)
	User Link	Feeder L/k	Voice (kbps)	Data (kbps)	
ARIES	L/S	C	4.8	2.4	<500
TELEDESIC	Ka	Ka	4.8	16-2048	9,000
ELLIPSO	L/S/C	L/S/C	4.8	0.3-9.6	600
GLOBALSTAR	L/S (up/d)	C	2.4, 4.8, 9.6	9.6	2,800 (48 satellites)
ICO	S	C or Ku	2.4, 4.8	2.4	4,600 (12 satellites)
ODYSSEY	L/S	Ka	4.8	9.6	3,000 (12 satellites)
IRIDIUM	L	Ka	2.4, 4.8	2.4	4,500

TABLE 3. PROPOSED BROADBAND GEO SATELLITE SYSTEMS (20/30 GHZ).

SYSTEM	COST	# OF SAT's	USER DATA RATE	USER DISH SIZE
Alenia Spazio EuroSkyWay	$500M (1st phase)	2 (1st phase) 5 (2nd phase)	144-2048 kbps (uplink) 32.768 Mbps (down/l)	45-60 cm (18"-24")
AT&T VoiceSpan	$3.2 B	12	32 kbps-1.544 Mbps	N/A
CellularVision	$207 M	1	N/A	N/A
EchoStar	$340 M	2	384 kbps-1.544 Mbps	N/A
GE Americom GE*Star	$4 B	9	384 kbps-40 Mbps	66 cm (26")
Hughes	$3.2 B	9	384 kbps-6 Mbps	66 cm (26")
KaStar Ladybug	$370 M	2	384 kbps	60 cm (23.5")
Lockheed Martin	$2.4 B	5	384 kbps-8.448 Mbps	66-120 cm (26"-47")
Loral (LAHI) CyberStar	$1.05 B	3	384 kbps-3.088 Mbps	70 cm (27.5")
Morning Star	$936 M	4	N/A	N/A
Motorola Millennium	$2.34 B	4	384 kbps-51.84 Mbps	70 cm (27.5")
Netsat 28	$250 M	1	384 kbps-1.544 Mbps	30 cm (12")
Orion	$1.6 B	8	64 kbps-2.048 Mbps	1.8-2.4 m (71"-94.5")
PanAmSat	$1.8 B	9	N/A	N/A

TOTAL NUMBER OF GEO SATELLITES: 74 ***TOTAL ESTIMATED COST: $22.2B***

TABLE 4. SOME PROPOSED BROADBAND LEO SATELLITE SYSTEMS.

SYSTEM	COST	# SAT's	FREQUENCY	USER DATA RATE	USER DISH SIZE
Celestri	$12.9B	63	20/30/40/50 GHz	2.048-51.84 Mbps	66-150 c m (26"-59")
M-Star (Motorola)	$6.15B	72	40/50 GHz	2.048-51.84 Mbps	66-150 c m (26"-59")
Skybridge(Alcatel	$2.7B	60	11/14 GHz	16 kbps-2.048 Mbps	35-150 cm (14"-59")
Teledesic	$9B	288	20/30 GHz	16 kbps-2.048 Mbps	30-150 cm (12"-59")

TOTAL NUMBER OF LEO SATELLITES: 483 ***TOTAL ESTIMATED COST: $20.75B***

Global EHF Satellite Systems for Delivering Fiber Optic Capacity World Wide

by Larry Bellagamba, Joe Freitag, Peter Stenzel, and Eric Wiswell

TRW Space & Electronics Group
Redondo Beach, USA

1. ABSTRACT

The Federal Communications Commission recently accepted applications to operate commercial satellite services in the extremely high frequency bands. This paper explains the exciting possibilities the spectrum provides the telecommunications industry.

2. BACKGROUND

In September 1997, satellite communications entered an exciting new era as 16 companies filed with the Federal Communications Commission (FCC) applications for licenses to operate commercial satellite services in the extremely high frequency (EHF), 36.1 to 51.4 GHz bands. Figure 1 summarizes the features of the filed systems.

EHF systems offer the potential of an additional 5 GHz of bandwidth for global wireless communications. The regulatory process will ultimately determine how much bandwidth will be available for use by satellite systems. The 16 filers propose applications ranging from mobile high data rate wireless communication to additional broadcasting capability.

This paper seeks to help telecommunications industry professionals understand the interest in the EHF spectrum and the exciting possibilities it holds by describing the Global EHF Satellite System Network (GESN) proposed by TRW.

Company	System Name	Service Type	Architecture NGSO(#planes) GEO (#slots)	Communications System		Cost ($B)	Data Rates (MB/S)
				Phased Array Antenna	On-Board Processing		
CAI Satcom	N/A	Fixed	1 GEO (1)	No	No	0.3	39
Denali	Pentriad	Fixed/Mobil	13 HEO (3@63.4°)	Yes	No	1.9	10 - 3875
GE Americom	GE*StarPlus	Fixed	11 GEO (9)	No	Yes	3.4	1.5-155
Globalstar	GS-40	Fixed	80 LEO (10@52°)	Yes	No	n/a	2 - 52
Hughes	Expressway	Fixed	14 GEO (10)	No	No	3.9	1.5 - 155
Hughes	SpaceCast	Broadcast	6 GEO (4)	No	No	1.7	0.4 - 155
Hughes	StarLynx	Mobile	20 MEO (4@55°) 4 GEO (2)	No	No	2.9	<2 portable <8 vehicle
LEO One USA	Little LEO	Mobile	48 LEO (8@50°)	No	No	0.3	.032 - .256
Lockheed Martin	Q/V-Band System	Fixed/ Broadcast	9 GEO (9)	Yes	Yes	4.7	0.4 - 1200
Loral	CyberPath	Fixed	4 GEO (4)	No	No	1.2	4 - 90
Motorola	M-Star	Fixed	72 LEO (12@47°)	No	No	6.2	2 - 52
OSC	OrbLink	Fixed	7 MEO (1@0°)	No	No	0.9	10 - 1244
PanAmSat	V-Stream	Fixed	12 GEO (11)	No	No	3.5	1.5 - 155
Spectrum Astro	Aster	Fixed	25 GEO (5)	No	No	2.4	2 - 622
Teledesic	V-Band Supplement	Fixed /Mobile	72 LEO (6@84.7°)	Yes	Tbd	1.8	10 -100 up 1000 down
TRW	Global EHF Satellite Network	Fixed	15 MEO (3@50°) 4 GEO (4)	Yes	Yes	3.4	1.5 - 1600

FIGURE 1. EHF SATELLITE FILINGS

3. MARKET DRIVERS FOR EHF SERVICES

Rapid growth in telecommunications services is being led by a steady demand for ever higher data rate services, spurred largely by the rapidly growing use of the Internet. For many on-line services, the smallest bandwidth of measure is now T-1, or 1.5 Mb/s. Demand for T-1 circuits is expected to continue growing well into the next decade. Market analysts predict that worldwide demand for T-1 equivalent circuits will more than double, to a value of $810 billion, by 2005.

The rapid growth of high data rate services threatens to outpace the capacity available by terrestrial networks. For example, KMI Corporation estimates that demand for transatlantic telecommunications, including voice, Internet data, non-Internet data, video, and other traffic may exceed the capacity supplied by transatlantic cables as early as 1999, even though capacity is being added at an unprecedented rate.

As the data offered over the Internet expand from text and graphics to video and three-dimensional virtual reality imaging, the requirement for bandwidth will continue to increase. T-3 (45 Mb/s) service, once used only by large telephone central offices, is now regularly used by many businesses, educational institutions, and research centers. To meet this growing demand, national and international carriers are deploying networks at OC-3 (155 Mb/s) and higher. New undersea fiber optic cables and terrestrial backbone networks often operate at rates of 10 Gb/s or higher.

Global EHF systems can help national and regional telecommunications service providers meet the increase in data communications demand, and at the same time provide "instant connectivity" between disparate networks and "instant infrastructure" in areas not adequately served by terrestrial systems.

4. BUSINESS PLAN CONSIDERATIONS

The global coverage of EHF systems involves service planning and investment levels considerably higher than the precursor local coverage C- and Ku-band systems. Much like the emerging global mobile satellite systems and Ka-band systems, the successful deployment of an EHF system will likely involve an international group of partners, each providing technical, marketing, or operational skills, and several stages of private and public financing.

The most important aspect of an EHF business plan is that it must be developed with a clear understanding of who the user is, what the user's needs are, and what the user is willing to pay for the service. This knowledge must then be used to drive the system design so that its service features and economics are consistent with those forecasted by the market. System providers' flexibility to accommodate this integrated approach to a system design that is compatible with a profit oriented business plan will be critical to the eventual financial success of the business.

Clearly, global satellite network deployment and operation mandates a collaborative and iterative working relationship between developers and users in developing a solid business plan. It is not uncommon for technical designs to be modified as new service offerings and new mixes of services are studied for market implementation. This iteration is anticipated in developing EHF systems, where large bandwidth will drive new applications and service offerings to the user community. TRW and the other filers are interested in substantive discussions with the user community to form the best technical, business, and service plans. We look forward to working closely with you and welcome your feedback.

5. PROPOSED SERVICES

EHF systems are a flexible medium for telecommunications transport with system capacity in excess of 1 Gb/s. Wholesale capacity of the system will be provided on a non-common carrier basis to telecommunications carriers, private network operators, and Government users needing low cost wideband communications. Potential applications of EHF systems are described below.

Long Distance Trunks. As falling trade barriers and increasing competition reduce tariffs and profit margins for domestic and international long distance carriers, the cost of the transport network becomes more significant in the price ultimately paid by the consumer.

With their rapidly installed and upgradable trunks between regions or continents, EHF systems relieve the pressure of increasing data traffic on existing fiber optic routes, reduce the need for additional capital investment, and free up bandwidth for the most delay sensitive applications.

Private Networks. Pervasive in business, private networks can be tailored to meet unique bandwidth, security, and cost goals. Private networks provide the majority of internal telephony and "intranets" for industries such as aerospace, automotive, broadcast distribution, entertainment production, medical, software, banking and finance, air and ground transportation, education, retail, and energy.

To connect many sites in a geographically dispersed network, satellite routing has significant performance and cost advantages over fiber optic and wireless alternatives. Studies have shown these advantages increase with:

- The distance between points to be connected
- The number of points in the network
- Variation in traffic loading on network paths
- Geographical or political boundaries between points in the network
- Frequency of relocation of network sites.

As company operations become more globally dispersed and joint ventures more common, the demand for flexible global networks is expected to soar. EHF systems will provide more capacity to private network users than all current satellite systems combined.

Government Applications. With private networks for diplomatic, military, public safety, and scientific purposes, governments have unique requirements for security, reliability, and very high bandwidth. These needs will continue to escalate as networking technology projects develop; the recently announced U.S. Government multi-agency next-generation Internet (NGI), is a prime example.

By operating at EHF frequencies between 40 and 50 GHz, satellite operators can offer additional bandwidth and many security and reliability advantages that have made EHF the choice for advanced military communications for over a decade.

With satellites in both MEO and GEO, an EHF system can provide seamless global connectivity to fixed and transportable ground sites, aircraft, the International Space Station, research satellites, and other users who need wide bandwidth with small terminal sizes. As already overburdened government satellite systems reach the end of their lifetimes, EHF will afford a commercial alternative for government users who do not require military-unique security or protection.

6. SYSTEM FEATURES

TRW anticipates the most financially attractive initial use of the EHF spectrum will be to augment existing trunk networks and large corporate networks. To do so, satellites must form a digital communications network that interfaces with existing and proposed terrestrial networks and other satellite networks. A key task is to include within the satellite system the real time digital signal processing and switching associated with terrestrial networks.

Fiber optic based networks profoundly advance broad band data communications. But they are geographically fixed assets, costly to field and maintain. Imagine the potential of offering fiber optic capability anywhere around the world, at a moment's notice, for any duration, with complete control over the capacity of each fiber. GESN seeks to offer such a dynamically configurable network. Further, it will enable communications providers to constantly optimize their network configurations in real time to maximize profits. GESN advantages can be summarized with respect to bandwidth on demand; data rate; availability; and latency.

Bandwidth. GESN offers bandwidth between 300 MHz and 3 GHz at any time for any duration.

Data Rates. GESN offers data rates of 155.5 Mb/s to 1.555 Gb/s at any time for any duration with bit error rates less than 10^{-10}.

Availability. Three factors determine space based communications system availability: 1) coverage, meaning the percentage of time satellites are in view; 2) probability the signal will not be attenuated due to rain; and 3) reliability of system components. At least one GESN satellite will always be above the horizon at least 30 degrees everywhere between ±60 degree latitude. For higher latitudes, at least one satellite is at least 30 degrees above the horizon more than 90% of the day. Because multiple satellites are nearly always in view of a user, redundant communications links are available to deal with traffic volume and system failures. These high minimum elevation angles reduce potential attenuation due to rain. The GESN system is sized to offer at least 99.5% availability using one ground terminal for continental or dryer climates. The primary propagation degradation at EHF frequencies is loss in received power due to rain. Rain-induced propagation losses depend on the severity of the rainfall rate, which, along with rain frequency, varies considerably around the world. The system is designed to operate for 15 years.

Latency. GESN was designed so a user would experience about the same latency associated with using LEO satellites. LEO satellites have less propagation delay since they are closer to the Earth's surface, but completing the communications link usually requires several satellites to handle the signal—and each satellite connection increases the user's net delay. GESN's longer propagation delay is compensated by minimizing inter-satellite connections.

7. TOTAL SYSTEM ARCHITECTURE

The GESN architecture shown in Figure 2 is composed of three major elements: a user segment, a ground segment, and a space segment.

User Segment. The User Segment connects GESN to the user's communications network. GESN user links operate in the 38 to 50 GHz region of the radio spectrum. The 47.2 to 50.2 GHz band is used in the Earth-to-space direction; the 37.5 to 40.5 GHz band is used in the space-to-Earth direction. Figure 3 summarizes key user terminal characteristics.

Parameter	Earth to Space	Space to Earth
Frequency (GHz)	47.2 to 50.2	37.5 to 40.5
Data rate (Mb/s)	155.5 to 1555.5	
Polarization	RHCP and LHCP	
Number of beams	2 transmit	2 receive
Antenna gain (dBi)	> 59	> 59
Antenna size	> 2.2m diameter	> 2.2m diameter
3 dB beamwidth	About 0.2 deg.	About 0.25 deg.
G/T (dB/K)		About 32
EIRP (dBW)	About 73	

FIGURE 3. GESN USER TERMINAL CHARACTERISTICS

The ground antenna is a key component of the User Segment. The larger the ground antenna, the higher the potential data rate, the less potential loss of signal due to heavy rain, and the less expensive the space segment. But, larger antennas cost more to obtain and operate. GESN was sized so that ground antennas with diameters between 1.5 m to 2.2 meters can provide data rates of 155.5 Mb/s to 1.555 Gb/s. For regions with extreme rainfall, antenna sizes may increase to 3 to 4 meters. Alternatively, if reduced availability is acceptable, smaller antennas (e.g., 0.5 meters) may be used for transportable systems.

The GSO satellites locations appear fixed relative to the ground; NGSO satellites slowly traverse an 120 degree arc relative to the ground. Antennas using NGSO links must articulate mechanically or electronically to minimize pointing losses. Applications requiring continuous connectivity need dual tracking

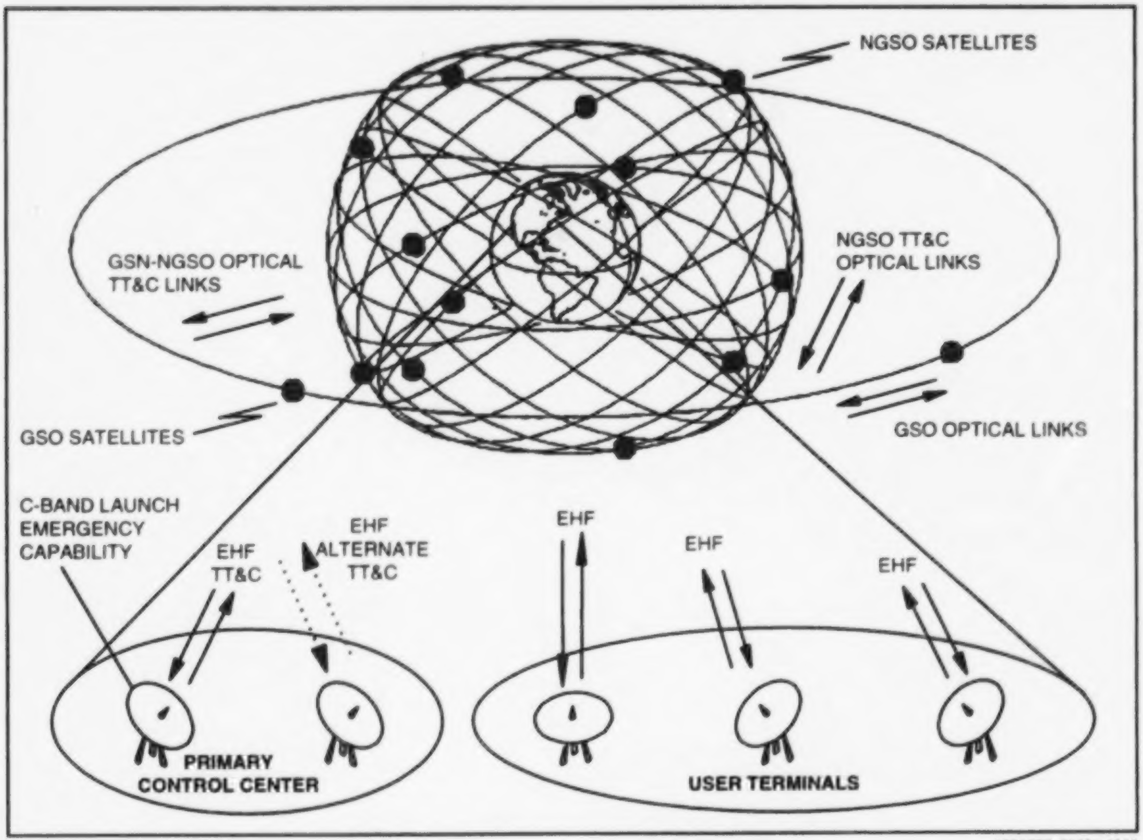
NGSO SATELLITES
GSN-NGSO OPTICAL TT&C LINKS
NGSO TT&C OPTICAL LINKS
GSO SATELLITES
GSO OPTICAL LINKS
C-BAND LAUNCH EMERGENCY CAPABILITY
EHF TT&C
EHF ALTERNATE TT&C
EHF
EHF
EHF
PRIMARY CONTROL CENTER
USER TERMINALS

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FIGURE 2. GESN SYSTEM ARCHITECTURE

antennas. Users who need better availability can use geographically dispersed antennas (thus increasing the likelihood that at least one is outside of any locally heavy rain) or can use larger antennas. A family of user terminals is anticipated, each matched to different user needs. Monolithic microwave integrated circuit (MMIC) devices have the potential to create flat panel phased array antennas of various sizes at attractive prices.

Ground Segment. The ground segment consists of two elements, network management and constellation control. Network management controls communication system resources and network operation and management, service access, status monitoring; and billing and accounting. Constellation control commands and controls the satellites. The key component is the Primary Control Center (PCC) which houses the people, hardware, software to perform these functions. To keep operating costs low, GESN has one PCC in the continental US, always visible to two GSO satellites over the western hemisphere. The PCC stations utilize EHF frequencies, with C-band frequencies available as backup.

Space Segment. Determining where to locate the satellites is a major trade. Figure 4 shows characteristics of different orbits. TRW elected to use a hybrid configuration consisting of GSO and NGSO satellites. The hybrid orbital GESN configuration offers:

- 33% of the latency times associated with pure GEO systems
- Multiple routing paths available for network reliability, congestion control, and adaptability
- Use of phased array antennas on the GESN GSO and NGSO satellites allows service to be directed to needed coverage areas instead of wasting valuable satellite resources over the ocean.

As shown in Figure 5, a communication path can be configured in several different ways. The GSO satellites will be launched prior to the NGSO satellites, thereby providing early GESN system availability to users over a large portion of the Earth's surface. Figure 6 summarizes the characteristics of each spacecraft.

Figure 7 shows the multiple satellite coverage (and hence the routing flexibility) afforded by GESN's combined NGSO and GSO satellite constellation. This Figure pertains to the portion of the Earth's surface bounded by ±60 degrees in latitude and between longitudes of 135 W. to 180 E.

NGSO Segment. GESN's 15 NGSO satellites (Figure 8) will operate at an altitude of 10,355 km, corresponding to a 6-hour orbit period. Satellites are distributed over three orbit planes (five per plane), which are inclined to the equatorial plane by 50 degrees. Within each plane, the satellites are

Elements/Constellation	Low Altitude (LEO) (< 1000 km)	Medium Altitude (MEO) (< 10,000 km)	GEO Altitude (35,000 km)
Orbital Considerations			
Signal time delay delay	Short est	**Medium**	Longest time
Spacecraft Elevation Angles	Rapid changes Satellites near horizon	Slow variations Satellities above horizon	No elevation angle variation
Van Allen Radiation	Low levels of radiation Magnetic field shield	Moderate levels of radiation RAD-hard	Low levels of radiation
Eclipse Intervals	Frequent day-night cycling (up to 10)	Infrequent day-night cycling (approximately four)	Infrequent day-night cycling (one)
Space Debris	Large numbers of debris	Smallest amount of debris	Some debris
Constellation Considerations			
Number of Satellities	Largest number of satellites	Moderate number of satellites	Least number of satellites
Cost of each satellite and Transport Cost	Lowest satellite cost Lowest transport cost	Moderate satellite cost Moderate transport cost	Highest satellite cost Highest transport cost
Satellite Lifetime	Shortest	Long	Longest
System Cost and Complexity			
Handoffs and Crosslinks (X-Links)	Frequent - requires x-links	Not required unless linked to GEO	Not required unless linked to LEO or MEO
Ground Control	High	Relatively low	Relatively low
Customer Premise Equipment	Highest	Moderate	Lowest
Incremental Startup Coverage	Low	Moderate	Best

FIGURE 4. CHARACTERISTICS OF COMMUNICATION SATELLITE CONSTELLATIONS

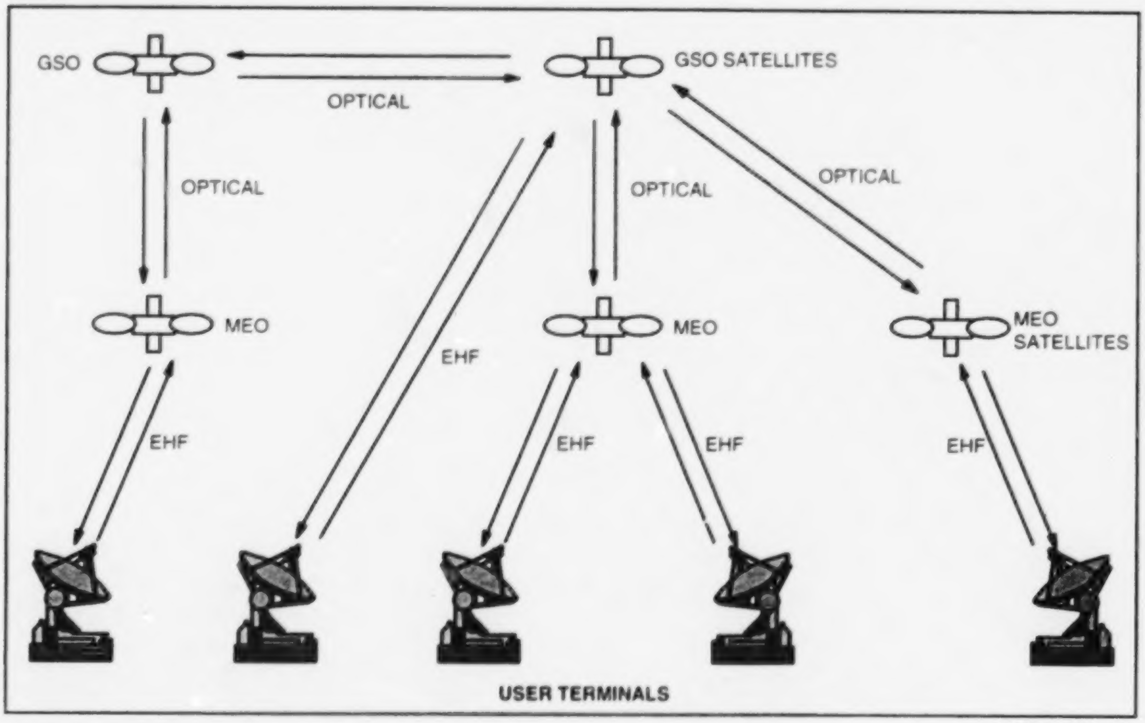

FIGURE 5. GESN COMMUNICATION PATHS

Satellite	GSO	NGSO
Number	4	15
Wet mass (Kg)	4603	5934
Design Life (years)	15	
Stabilization	3 axis using reaction wheels and thrusters	
DC Power (KW)	12.7	15.5
Eclipse Capability	100%	
Deployed Length (feet)	90	120
TT&C Antennas	2 C-Band Omni	
Number of EHF beams	32	48
Antenna Field of View (degrees)	15	39

FIGURE 6. SUMMARY OF SATELLITE CHARACTERISTICS

72 degrees apart. The interplane satellite phasing is 24 degrees. The right ascension of ascending nodes is 120 degrees apart. The NGSO constellation provides 100% coverage at a minimum elevation angle of 30 degrees for all latitudes between 0 and 60 degrees. Coverage at latitudes between 60 and 70 degrees is at least 98 %. Coverage at the northernmost portion of Alaska is at least 96.6 %.

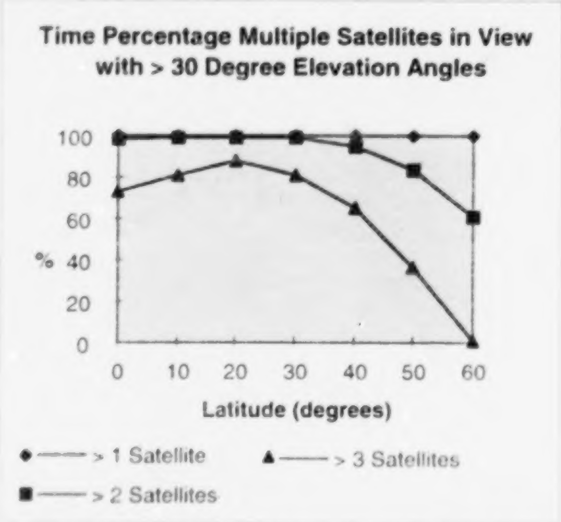

FIGURE 7. TIME MULTIPLE SATELLITES VISIBLE VERSUS EARTH'S LATITUDE

GSO Element. The four GSO satellites (Figure 9) will be located at 113 W, 83 W, 15W and 112 E longitude. Figure 10 shows the coverage GSO satellites afford for minimum elevation angles of 30 degrees. In addition to providing alternative user links and interconnections between satellites, GSO satellites provide a sparing capability for the NGSO satellites over a wide range of user latitudes.

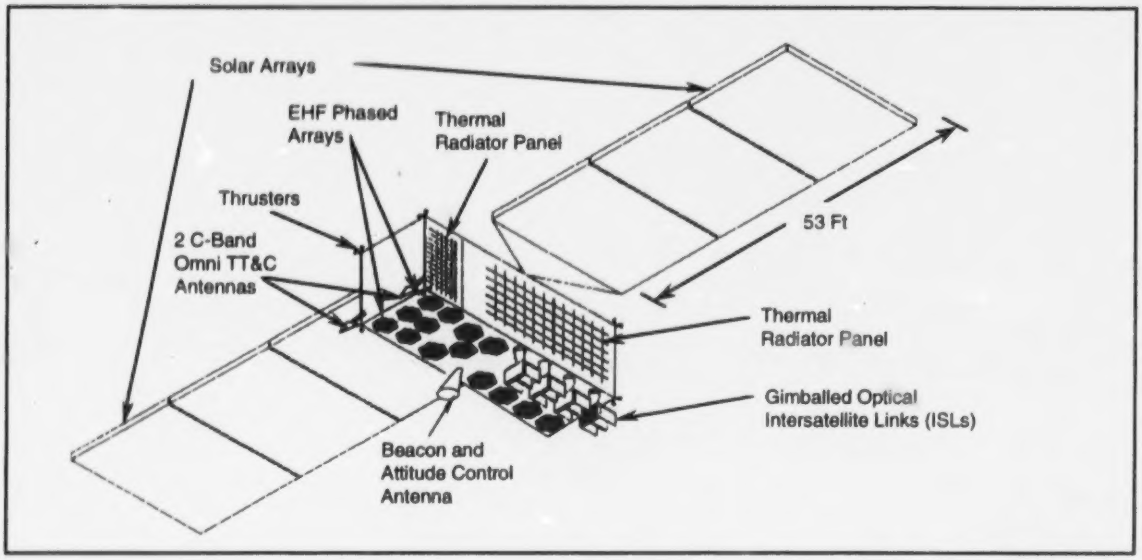
Solar Arrays
EHF Phased Arrays
Thermal Radiator Panel
Thrusters
2 C-Band Omni TT&C Antennas
53 Ft
Thermal Radiator Panel
Gimballed Optical Intersatellite Links (ISLs)
Beacon and Attitude Control Antenna
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FIGURE 8. GESN NGSO SATELLITE CONFIGURATION

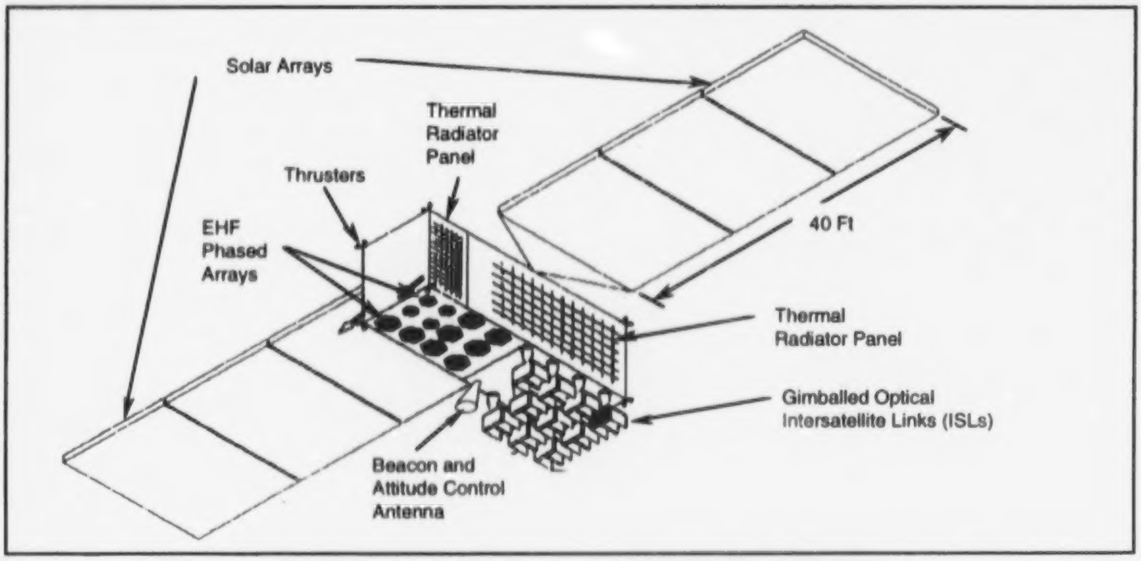
Solar Arrays
Thermal Radiator Panel
Thrusters
EHF Phased Arrays
40 Ft
Thermal Radiator Panel
Gimballed Optical Intersatellite Links (ISLs)
Beacon and Attitude Control Antenna
9702777-3006b-154A

FIGURE 9. GESN GSO SATELLITE CONFIGURATION

Launch Vehicles. The GSO and NGSO satellites will be launched one at a time by suitable vehicles. The NGSO satellites will be designed to be compatible with two selected launch vehicles.

TRW's GESN Payload. The payload architecture is similar for both the GSO and NGSO components of the system. All GESN payloads have seven elements: an EHF subsystem, a digital processor, an intersatellite link (ISL) subsystem, a payload computer, a beacon, access control, and timing subsystem, a telemetry, tracking and command subsystem, and a timing and frequency generation subsystem. Figure 11 shows a payload block diagram. This common architecture is then specialized to the different functional requirements of GSO and NGSO operation. The only essential difference in the payloads concerns the number of intersatellite links carried on the respective

69

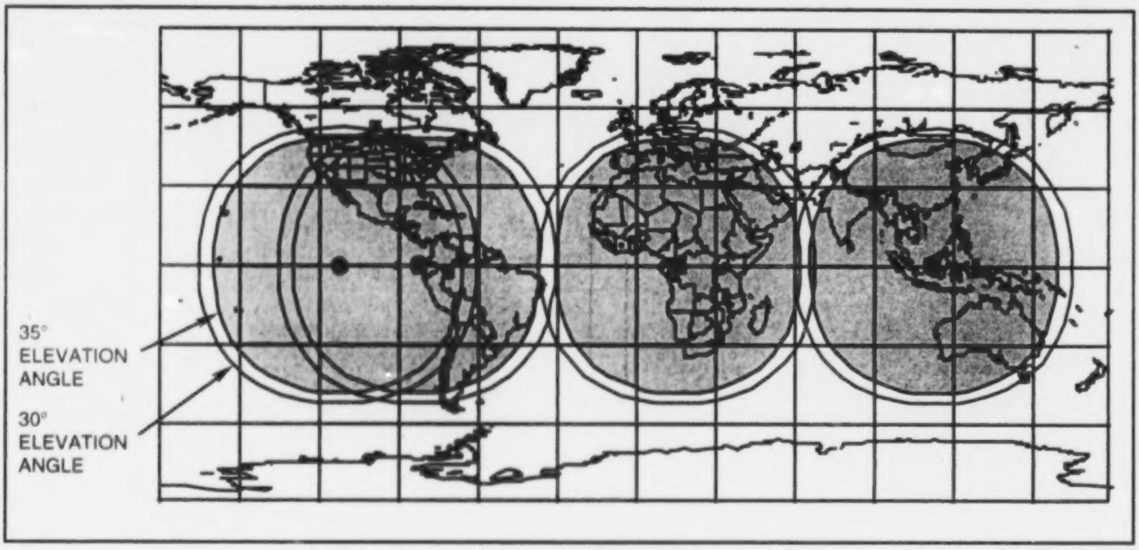
35°
ELEVATION
ANGLE
30°
ELEVATION
ANGLE

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FIGURE 10. GESN GSO SATELLITE COVERAGE

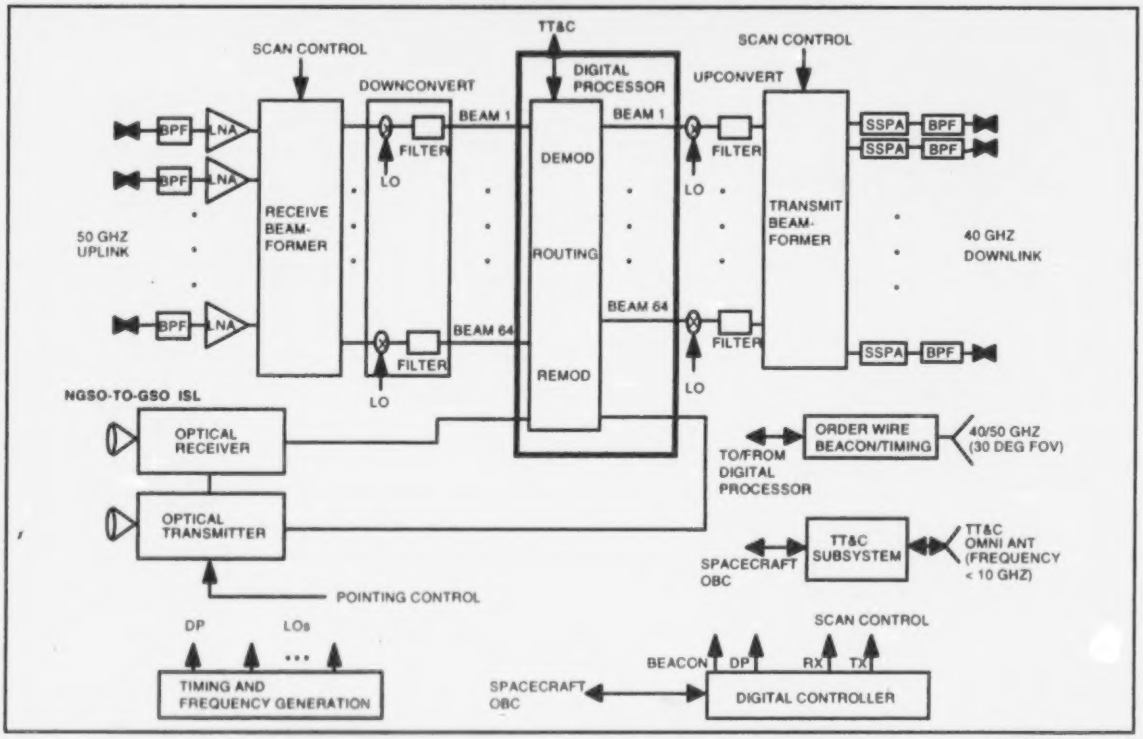
TT&C
SCAN CONTROL
DOWNCONVERT
DIGITAL PROCESSOR
SCAN CONTROL
UPCONVERT
BPF
LNA
RECEIVE BEAM-FORMER
FILTER
LO
BEAM 1
DEMOD
ROUTING
REMOD
BEAM 64
TRANSMIT BEAM-FORMER
SSPA
50 GHZ UPLINK
40 GHZ DOWNLINK
NGSO-TO-GSO ISL
OPTICAL RECEIVER
OPTICAL TRANSMITTER
POINTING CONTROL
ORDER WIRE BEACON/TIMING
40/50 GHZ (30 DEG FOV)
TO/FROM DIGITAL PROCESSOR
TT&C SUBSYSTEM
SPACECRAFT OBC
TT&C OMNI ANT (FREQUENCY < 10 GHZ)
DP
LOs
TIMING AND FREQUENCY GENERATION
SCAN CONTROL
BEACON
DP
RX
TX
SPACECRAFT OBC
DIGITAL CONTROLLER

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FIGURE 11. NGSO PAYLOAD BLOCK DIAGRAM

payloads. For the GSO satellites, the initial payload design carries 10 optical ISLs; the NGSO payloads each carry four ISLs. The exact number of ISLs is determined as requirements and business cases dictate.

The antenna systems are designed for the high gains required for the served data rates and for beam coverage reconfigurability. Identical phased array antenna concepts for both GSO and NGSO give considerable economic advantages in addition to operational flexibility. Phased array antennas are used for both transmit (37.5 to 40.5 GHz) and receive (47.2 to 50.2 GHz) functions. These antennas take full advantage of MMIC technologies in their design. Electronics heritage comes directly from commercial (e.g., Ka-band) and military (e.g., MILSTAR) projects. The GSO satellites will use 32 beam phased arrays; NGSO satellites will use 48 beam phased arrays. These beam counts reflect the balance between EHF transmit power requirements and power requirements of the optical ISLs.

Based on instructions from the payload computer, the phased array beams are pointed in the desired direction to receive the uplink signal. The received signal is then passed through a low noise amplifier, downconverted, and filtered. The IF signal is then digitized, demodulated, and decoded by the digital processor. The baseband signals are then passed to the router where the packets are routed to the appropriate downlink beams or intersatellite link subsystem. After the signals are routed to the proper link, they are encoded, multiplexed, modulated, and passed through the high power transmitters. For the EHF transmit phased arrays, the high power amplifiers are SSPAs associated with the phased array antenna elements. The optical ISL transmission subsystem consists of gimbaled laser communication elements and the appropriate pointing, power amplification, and modulation equipment.

The beacon and access control subsystem consists of narrow bands reserved at the upper end of the transmit and receive EHF spectrum, providing users with a continuous beacon for tracking and timing purposes, signals to assign channel and time slots, and dedicated spectrum for user access requests of the system. TT&C will be accomplished through the EHF communication system when the system is on orbit. The onboard timing and frequency generation subsystem provides local oscillator generation and timing signals for the beacon digital processors. Figure 12 summarizes communication system parameters for TRW's GESN system.

8. SYSTEM COST AND DEPLOYMENT SCHEDULE

Each of the EHF files outlined their expected system costs (Figure 1) and deployment schedule. Multiple satellite systems typically require 3 to 4 years to launch from grant of license, with full system operation achieved 1 to 2 years later. Currently, a license is expected in late 1999 or early 2000.

9. SUMMARY

The recently submitted EHF satellite constellations can deliver the communication capacity of fiber optic cable from space—with benefits fiber can't match. Chief among these benefits are:

- Global trunking service for telecom carriers, international business, and government agencies
- Flexible service plans that allow bandwidth-on-demand
- Rapid installation, quick upgrades, and flexible routing inherent to satellite service.

TRW's GESN is a satellite constellation consisting of 4 satellites in geostationary orbit and 15 satellites in non-geostationary orbit employing advanced phased-array antennas, on-board data processing, featuring data rates from 1.6 Mb/s to 1.6 Gb/s. The constellation provides global coverage with minimum elevation angles of 30°. Small user terminals can operate at a bit error rate of 10^{-10}.

The EHF satcom filers are expected to be licensed by the FCC by late 1999 and be operational by 2003.

	GSO User Link		NGSO User Link	
Parameters	Earth-to-Space	Space-to-Earth	Earth-to-Space	Space-to-Earth
Frequency	47.2 to 50.2 GHz	37.5 to 40.5 GHz	47.2 to 50.2	37.5 to 40.5 GHz
Bandwidth	3.0 GHz	3.0 GHz	3.0 GHz	3.0 GHz
Polarization	RHCP & LHCP	RHCP & LHCP	RHCP & LHCP	RHCP & LHCP
Antenna Field-of-view	15 degrees	15 degrees	39 degrees	39 degrees
Antenna	Phased array subsystem	Phased array subsystem	6 phased array apertures; 8 beams per aperture	8 phased array apertures; 6 beams per aperture
Number of beams	32 scanning beams	32 scanning beams	48 scanning beams	48 scanning beams
Antenna gain	53 dBi	53 dBi	46.5 dBi	46.5 dBi
3 dB beamwidth	0.4 deg	0.4 deg	0.8 deg	0.8 deg
G/T	24.4 dB/K	-	17.9 dB/K	-
EIRP	-	83 dBW	-	78.0 dBW

FIGURE 12. COMMUNICATION SYSTEM PARAMETERS

Latency in Satellite Networks

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Abstract

Latency - which simply means delay - is one of the basic parameters that determines a network's Quality of Service. Network delay can create difficulties and inconveniences with voice, Internet protocols, and client-server applications, which is causing customers to increasingly demand low latency networks. The ability of a non-geostationary satellite network to offer fiber-like latency to ensure seamless compatibility with terrestrial networks is an important competitive advantage over traditional, high-latency geostationary satellites.

Quality-of-Service (QOS) is essential to the current and future markets for telecommunications. QOS refers to the performance guarantees that a network can offer to its users, which determines what the network can be used for. Latency – which simply means delay – is one of the basic parameters that determines a network's QOS. Teledesic's ability to offer fiber-like latency to ensure seamless compatibility with terrestrial networks is an important competitive advantage over traditional, high-latency geostationary satellites.

How does latency affect voice?

The latency inherent in GEOs is the source of the annoying delay in many intercontinental telephone calls, impeding understanding and distorting the personal nuances of speech. Because voice users are not willing to accept the high latency inherent in GEOs, these systems are being phased out for both trunking and backup. Latency in voice communications becomes noticeable with a round-trip delay of 100 to 200 msec. Because of their great distance from Earth, GEOs have minimum round-trip latency of 500 msec.

How does latency affect client/server protocols?

Client/server applications such as Exchange, PeopleSoft, and SQL Server represent the main use of computer networks. All of these rely on "transaction-oriented" application-layer protocols that consist of large numbers of low bandwidth requests and responses. Additionally, using modern "challenge-response" authentication protocols such as Kerberos and performing address lookups using the Domain Name System (which occurs before all Internet connections are established) also require numerous low-bandwidth round-trips.

These protocols were developed on and deployed over low-latency LANs and WANs. The protocols they employ are optimized on a number of factors (e.g., allowing "roll-back" of unconfirmed transactions, low use of bandwidth, stateless transactions, etc.). However, minimizing the number of round-trips is rarely if ever one of the factors taken into account in their design.

This can result in unacceptable performance over GEO networks. For example, accessing and updating a customer record from an SQL Server across the country may take 20 round-trip transactions. Over a fiber connection (or Teledesic), this will take between 0.75 and 1.5 seconds. Over a GEO, it will take at least 10 seconds. Both networks may be offering the same nominal bandwidth, but the GEO communication can take many times longer because of the inefficiency of performing multiple small transactions over a high-delay network.

How does latency affect Internet protocols?

There are three main issues regarding latency in Internet protocols:

1) The default "window size" in many TCP/IP protocol implementations acts as a bottleneck on communications over high-latency links. The window size represents the amount of information being stored in case a transmission error occurs. On many implementations, the standard window prevents sending enough data to fill a high-latency connection.

For example, the default buffer size in both the Windows 95 and Windows NT implementations of TCP/IP is 64 kilobits. This means that at any given moment, only 64 kilobits can be in transit and awaiting acknowledgment. No matter how many bits a GEO link theoretically can transmit, it still takes at least half a second for any 64 kilobits to be acknowledged. So, the maximum data throughput rate is 64 kilobits per 1/2 second, or 128 kbps.

The impact for users is that over a 2 Mbps GEO link, one would expect to be able to transmit about 2 Mbps worth of data. In fact, any connection via a geostationary satellite would be constrained to only 128 kbps, which is less than 7% of the purchased capacity.

There are technical approaches to resolving this issue (e.g., RFC 1323, which enables larger windows), but they are not widely deployed and may not be feasible in many situations (e.g., a busy web server may not have the memory to support numerous large window connections). Moreover, because TCP is an end-to-end protocol, trying to fix latency issues requires modifying the protocols of *every* computer with which one might want to communicate. Network managers do not want to have to modify their protocols or installed base to deal with non-standard networks.

2) TCP includes two essential congestion control mechanisms called "slow start" and "congestion avoidance." These mean that all Internet connections (such as viewing web pages and sending e-mail) start out at lower bandwidth and then throttle up to higher speed if no congestion is encountered. The problem is that each cycle of speed increase requires a full round-trip communication between sender and receiver, and dozens of such round-trips can be necessary to reach the full potential of a link. When a round-trip takes 500 msec or more, as is the case with a GEO, the communication often ends before the connection can ever reach the full bandwidth of the link.

For instance, once the congestion avoidance algorithm kicks in, it can require 200 round-trips (which, even in ideal conditions, takes almost 2 minutes) for a GEO link to get back up to T-1 bandwidth. Most likely, the transmission will have ended by then, with the information having been transferred at sub-optimal rates.

There is research underway to better understand this issue, but it is unlikely that the slow start and congestion avoidance mechanisms can be removed from TCP without causing a "congestive collapse" of the Internet.

3) There are research efforts to look at increasing the performance of TCP over GEOs by "spoofing" the connection to trick the other side into believing it is communicating with a low-latency link. These schemes fundamentally alter the semantics of TCP communications, introducing the possibility of data corruption. Moreover, they are incompatible with the IP security protocols (IPsec), which promise to bring an unprecedented and badly needed degree of security to the Internet. The next generation Internet Protocol, IPv6, which mandates the use of IPsec authentication, will not function over a spoofed link. IPsec is also being implemented now on top of Ipv4.

Is this only an Internet issue?

There is a wide consensus that TCP/IP is one of the most important and widely distributed technologies in modern networking. But many other networking technologies have even greater problems with high latency. For example, the standard mainframe and minicomputer communications protocols – SNA and DEC LAT – generally will not work at all over high-latency links.

How does latency affect Bandwidth-on-Demand?

One of the most compelling aspects of a "shared-bus" communications medium such as many wireless systems is the ability to offer Bandwidth-on-Demand (BoD). BoD allows a user to request and release capacity as needed. This enables users to pay only for the capacity they actually use, and for the network to support a much higher number of users.

For example, the pause between sentences in an Internet telephone transmission can be used to transmit best-effort services such as e-mail. This statistical multiplexing (allowing several users to share a network resource) is only feasible if both transmitters (user terminals) can dynamically negotiate bandwidth demands with the network (satellites). The high latency in a geostationary satellite system drastically reduces the efficiency of any statistical multiplexing because by the time the resources can be scheduled, they may no longer be available.

What sets the standard for latency?

The difference between Teledesic and GEO latency – GEOs have five to 25 times more delay than Teledesic – is more important than the simple ratio makes clear. This is because protocols and applications are not designed for zero-delay networks; they are designed for today's real-world terrestrial networks, for which fiber sets the standard.

Teledesic is designed to have the same essential QOS characteristics as fiber. That means that applications and protocols that work over fiber will work the same way over Teledesic. The point is for the application not to know it's going over a satellite. Teledesic can act as a seamless extension of the Internet and other terrestrial networks. As soon as you move away from the QOS available on terrestrial networks, that seamless compatibility no longer holds, and applications can start breaking.

Can the latency-sensitive applications be separated out?

One of the fundamental principles of the Internet is the notion of all applications moving on to a common network platform – an open network based on common standards and protocols. The idea of stand-alone, proprietary networks, or application-specific networks, is fast disappearing. All applications will move over the same networks, using the same protocols. In these packet-switched networks – where voice, video, and data are all just packets of digitized bits – it is not practical to separate out applications that can tolerate delay from those that cannot. As a result, the network should be designed for the most demanding application.

How is the market responding to user concerns over latency?

For the reasons described above, latency is one of the most important customer criteria in evaluating the QOS of a communications link. Major Internet Service Providers (ISPs) are responding to the demand for high-quality service by offering guarantees of low-latency performance. For example:

- UUNET guarantees less than 150 msec end-to-end latency for two sites on its network.
- Concentric guarantees less than 150 msec end-to-end latency for two sites on its network.
- AT&T WorldNet guarantees less than 100 msec latency on its backbone.
- Sprint guarantees less than 140 msec latency on its backbone.

Finally, the Automotive Network eXchange (ANX) has begun a program to accredit Certified Service Providers that will provide TCP/IP-based Virtual Private Networks for connecting auto makers and their suppliers. This rigorous certification program will involve ongoing compliance testing of more than 100 different service criteria such as availability and throughput. The ANX is one of the most important things happening to evolve the Internet for business.

The ANX will mandate that the maximum allowable latency for connections is 125 msec. This figure came directly from analyzing the demands of the auto industry's mission-critical applications.

Over time, customers expect more from communications links, just as they do from software. Thus, it is likely that these guarantees will only grow more stringent as more and more mission-critical applications are migrated to the Internet and QOS-guaranteed Virtual Private Networks such as the ANX.

How is Teledesic going to satisfy the market expectations for high QOS?

The Teledesic Network is not trying to replicate today's best-efforts, unevenly-reliable Internet. The QOS guarantees that major ISPs are beginning to make are already setting a standard that Teledesic will have to meet. Teledesic's approach is to conform its network to the market requirements rather than require that the market conform to the limitations of a GEO. Teledesic's Internet-in-the-Sky is designed to provide end-to-end QOS that enables global enterprise networking, meeting the demands of the Internet of the future. QOS design parameters include:

- *Multi-megabit, Bandwidth-on-Demand (BoD).* Terminals will be able to request and release capacity in less than 50 msec, resulting in extremely efficient statistical multiplexing.
- *Fiber-like Bit Error Rates (BER).* Use of Forward Error Control (FEC) will provide BER of less than 10^{-10}, creating an essentially noise-free channel.
- *Fiber-like availability.* Availability of 99.9% or higher, enabled by Teledesic's 40 degree elevation angle among other features, will provide higher uptime than many terrestrial links.
- *Fiber-like latency.* End-to-end (one-way) latency will be as low as 20 msec and less than 75 msec on all links of less than 5,000 km. Round-trip (two-way) latency will be less than 100 msec on most connections.

When customers evaluate GEO versus LEO broadband satellite links, they will need to decide whether they are willing to make do with bandwidth constraints, protocol hassles, and "choppy" real-time applications, or whether they want connections with the same essential characteristics of fiber. Instead of attempting to ensure the compatibility of the entire installed base of network equipment with which one might want to communicate, receiving seamless compatibility with standard, fiber-based terrestrial networks becomes increasingly attractive.

Any specific latency problem in a protocol or application may be individually solvable. But when taken together, these problems are indicative of the business risks of building networks that diverge from terrestrial standards. Not that long ago, no one had heard of the World Wide Web. What telecommunications carrier wants to take the chance that the next killer application – or the one after that – will simply not work over its network? By deploying a network that is seamlessly compatible with fiber, Teledesic can help ensure that customers can use the next generation of applications – whatever they may be and wherever they are needed.

Socio-Economic Implications of GMPCS: A Case of ICO*

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ABSTRACT

This paper aims to study how GMPCS will be a pivotal means of filling the missing link between the haves and have-nots by looking at various socio-economic benefits and regulatory challenges of GMPCS in the global telecommunity. It also examines whether GMPCS demonstrates to pave a new way of interdependence between the developed and developing world.

Numerous studies have emphasised on a widening gap between the haves and have-nots of telecommunications infrastructures and a critical role of telecommunications in developing the overall economies and promoting health, education, environmental protection and even democracy, particularly in the developing countries. Even today, some telecommunications traffic in certain countries, African countries *inter alia*, are still going through either London or Paris, which are the former colonial capitals, for their local and regional calls.

However, hardly any particular solutions have been suggested to bridge the gap and to develop the overall economies through telecommunications in many developing countries.

This paper aims to demonstrate that an emerging telecommunications technology and service called global mobile personal communications by satellite (GMPCS) such as ICO, will be a - if not, "the" - pivotal means to fill the missing link and also contribute to socio-economic welfare in the global telecommunity, the developing countries *inter alia*.

Furthermore, it examines whether the advent of GMPCS demonstrates to pave a new way of *interdependence* -"reciprocal effects among different countries"[1] in a political sense, and "a technical interconnection leading to world economic interdependence"[2] in a techno-economic sense - between the developed and developing world.

1. What is GMPCS ?

1.1. Definition of GMPCS

GMPCS originally attracted the world's attention because of its new concept of offering mobility of terminals using multiple satellites in non-geostationary orbits with global coverage.

However, its scope and definition became broader during and even after the first World Telecommunication Policy Forum held under the auspices of the International Telecommunication Union (ITU/WTPF) in October 1996.

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* This paper reflects only author's views, which are not necessary to be the same as those of her organisation.

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According to this new definition, a GMPCS system can be "any satellite system (i.e., fixed or mobile, broadband or narrowband, global or regional, geostationary or non-geostationary, existing or planned) providing telecommunications services directly to end users from a constellation of satellites"[3] It covers almost all satellite systems which contain such elements as mobile communications services and/or satellites.

1.2. Characteristics of GMPCS

Although each system may differ from the others, most GMPCS are mainly composed of three segments: *space segment* with multiple satellites either in geostarionary earth orbit (GEO), medium (MEO), or low (LEO); *ground segment* with earth stations and other facilities; and *user segment* with mobile handheld terminals or speciality ones (e.g., vehicular, aeronautic, maritime, fixed or semi-fixed village phones etc.).

As illustrated in ICO system diagram (see Figure 1), ICO needs only 10 operational satellites arrayed in two orbital planes in a medium earth orbit (MEO), approximately 10,355 km above the Earth; 12 earth stations called satellite access nodes (SAN) around the world which will link with the existing PSTNs and PLMNs; and various types of terminals subject to demands from users world-wide.

1.3. Comparision of major GMPCS

Although ICO, Globalstar, Iridium and so on are all categorised as GMPCS, as explained in Table 1, each system has its own technical and commercial features.

<Table 1: MAJOR ASPECTS OF THE MAIN GMPCS>

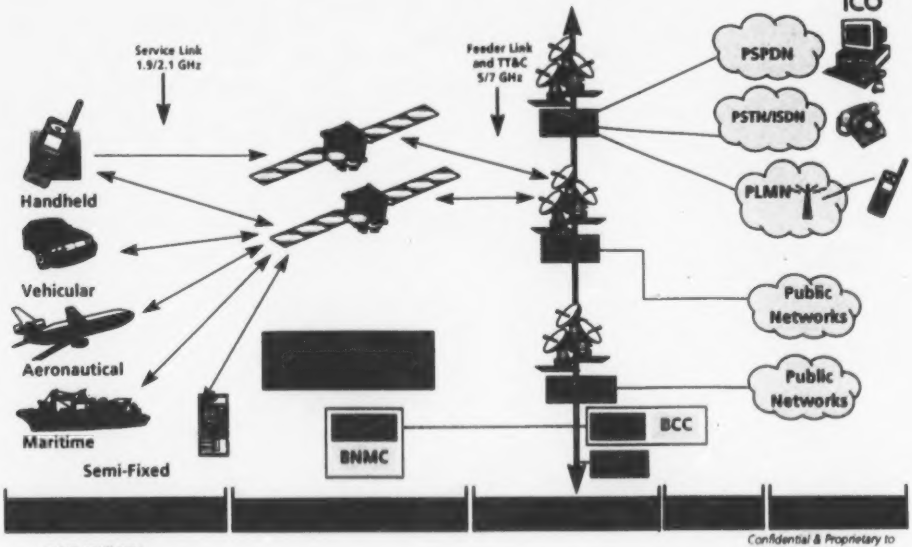
	ICO	**Globalstar**	**Iridium**	**Odyssey**	**Regionals***
Type	MEO	LEO	LEO	MEO	GEO
Orbital height	10,355 km	1,410 km	780 km	10,354 km	36,000 km
No of satellites + spares	10 + 2	48 + 8	66 + 6	12 + 3	1 + 1
No. of beams per satellite	163	16	48	61	variable
Channels per satellite	4,500	2-3,000	1,100	3-9,000	<15,000
Access	TDMA	CDMA	TDMA	CDMA	TDMA
Financing	advanced	advanced	advanced	uncertain	some advanced
Main services	voice 9.6kbps data SMA fax paging position-reporting speciality	voice 7.2kbps data fax SMA paging position-reporting	voice 2.4kbps data fax SMA paging position-reporting	voice 9.6kbps data fax paging position-reporting	voice 4.8kbps data SMS fax
Planned in service date	2000	1998/9	1998 start-up	2001	1999

* EAST, APMT, ASC, ACeS

{source: Nigel Stevens, *International Telecommunications*, October 1997, pp.63 & 69 with some modifications }

<Figure 1: ICO SYSTEM - OVERALL CONFIGURATION>

ICO


Service Link
1.9/2.1 GHz
Feeder Link
and TT&C
5/7 GHz
PSPDN
PSTN/ISDN
PLMN
Handheld
Vehicular
Aeronautical
Maritime
Semi-Fixed
[redacted]
[redacted]
[redacted]
[redacted]
Public
Networks
Public
Networks
[redacted]
BNMC
[redacted]
BCC
[redacted]
[redacted]

icov1.ppt - June 97, page 1

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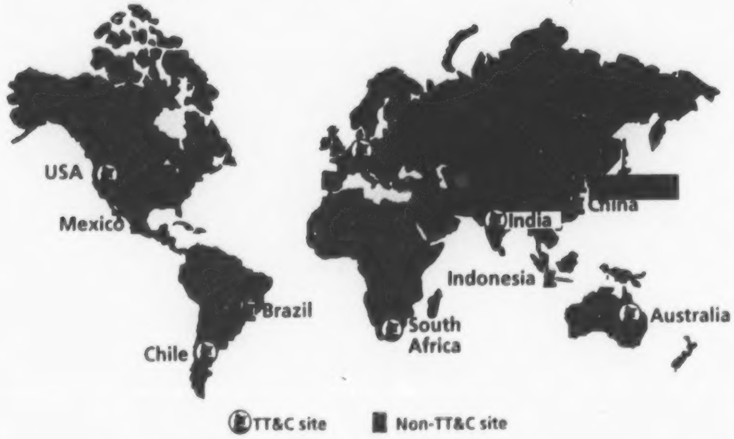
<Figure 2: ICO SAN SITE LOCATIONS>

ICO


USA
Mexico
Brazil
Chile
South
Africa
India
China
Indonesia
Australia
[redacted]
[redacted]
TT&C site
Non-TT&C site

ICO is planning 12 SANs around the globe. They will be interconnected with terrestrial networks so that calls can be made between ICO terminals and terrestrial phones (both fixed and mobile).

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2. Socio-Economic Benefits of GMPCS

Although various GMPCS may differ from one another, ICO believes that its service and business *inter alia* will benefit the world, particularly the developing countries in the following ways:

2.1. Various Layers of Partnership

Unlike the existing multinational corporations, particularly in the telecommunications sector, the GMPCS industry in practice opened up new ways of partnerships or interdependences between the developed and developing world, ranging from space, ground to user segments.

At the level of space segment, most GMPCS systems, including ICO, are invested in by many developing countries. For instance, some 40 out of 51 ICO investors are actually from the developing countries, mainly in Asia and Africa.

At the ground and user segments, ICO also has a couple of strategic partners. For examples, Hughes Space and Communications International Inc. (USA) is responsible for the design, development and manufacturing of 12 satellites and associated telemetry, tracking, and control equipment for ICO[4] ; a consortium led by NEC Corporation (Japan) for the design, manufacture, construction, installation, and testing of ICO's own ground network (i.e., ICONET)[5] ; and Samsung Electronics Co. (Korea) together with others who will manufacture and supply ICO's dualmode handphones, which are compatible with CDMA, TDMA, GSM and so forth.

This form of business arrangement is uniqued since the relationship should not be based on the traditional dependence between the centre and peripheries but on interdependence between the participating entities - i.e., reciprocal partnerships.

2.2 Joint Ventures (JV) with Local Partner

The concept and practice of joint ventures (JVs) between local entities and foreign companies are not new at all. In fact, many national champions in the telecommunications sector are nowadays forming alliances (e.g., Unisource, World-Partner etc.) with each other to offer services globally and to meet fierce competition world-wide.

Unlike such existing alliances among gigantic national champions, the GMPCS industry offers a new type of JVs, through which various layers of local entities in both the developed and developing countries can take a part for various reasons ranging from requirements for national regulatory approvals and local knowledge to business plans.

Taking into account the unique natures of GMPCS such as global partnership and requirement of speedy access to the global markets, in practice, it is essential to optimise various distribution channels (e.g., PTTs, PTOs, cellular/PCS operators, aeronautic, maritime, trucking, governmental organisations etc.).

In the case of ICO, ICO itself will neither distribute nor support its products in any country or region. The various functions and players in this global partnership will belong to the service partners[6], which will be a wide variety of local entities *per se* in the relevant countries.

2.3. Job Creation at Local Levels

World-wide participation in the ownership and JVs of GMPCS is anticipated to create more jobs for local people with a sprit of enterprise.

At the ground segment, many GMPCS systems plan to build earth stations which will interconnect with the existing terrestrial networks. As seen in Figure 2, ICO has selected and contracted with its SAN sites linking and covering every corner of the hemispheres. Building and operating such facilities will without doubt create local jobs and establish a local presence.

ICO has also established a number of regional offices throughout the world (e.g., Brazil, South Africa, Lebanon, Russia, Nigeria, India, Latin America, and LA, Washington DC, Chicago, Denver in the USA and more to come) to support and assist service partners and/or investors in the countries concerned for regulatory approvals as well as local and regional marketing.

Moreover, a great number of new and additional jobs, ranging from those providing services in individual countries to those manufacturing equipment, have already been and are to be created in both the developed and developing world. Indeed, some 2,000 jobs are estimated in the USA alone, through contracts with U.S. companies to implement the global satellite system[7].

2.4. Revenue Sharing

Some may be concerned about the potential for bypass by GMPCS of their existing telecommunications infrastructures. Yet, it is important to note that most GMPCS do neither intend to replace existing networks nor is it feasible to do so in terms of technical functionality and capability.

As demonstrated in Figure 3, the cellular coverage world-wide will be very limited even in the year 2000. Thus, most GMPCS systems are being designed to complement and augment the existing telecommunications infrastructures, especially where there are limited alternatives or even no alternatives, as in many rural and remote areas.

As a matter of fact, their business practices are expected to share revenues between the participating entities by generating more telecommunications traffics through GMPCS to the existing terrestrial and cellular networks: i.e., the better performance, the more profits to be shared.

2.5. Transfer of Technology and Managerial Know-How

One of the critical weakness that most of the developing countries have chronically faced is lack of human resources. The business arrangements and unique world-wide partnerships offered by GMPCS - ICO *inter alia* - will be contributing to transfer of technological, operational, and managerial skills to local employees especially in such areas as the state-of-the-art technologies (e.g., satellites in LEOs and MEOs, ground earth stations, and a variety of user terminals from dual-mode mobile phones to speciality ones).

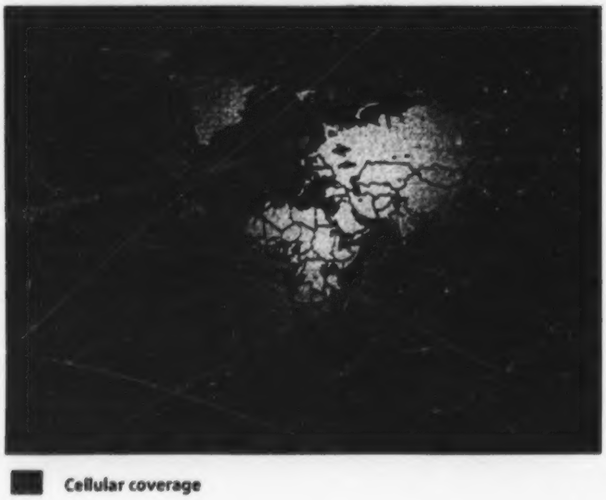
2.6. Universal Access

The growing awareness concerning the significant role of telecommunications not only in daily life but also in overall socio-economic growth has undoubtedly contributed to universal service or access becoming even a political priority in many countries.

Indeed, at the G-7 Summit on the information society held in Brussels (1995), "ensuring universal provision of and access to services" was identified as one of the eight core principles behind the realisation of their common vision of the Information Society[8].

This concern has been more deeply expressed by the developing countries - their rural areas *inter alia*, where their teledensity is very poor with lack of telecommunications infrastructures, as illustrated in Table 2.

<Figure 3: CELLULAR COVERAGE IN THE YEAR 2000>


Cellular coverage

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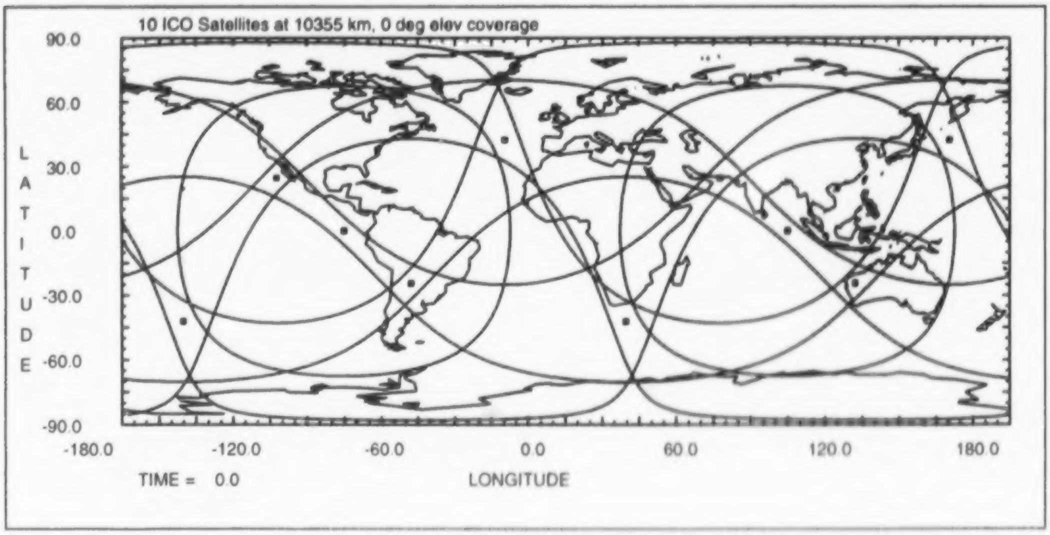
<Figure 4: ICO SYSTEM COVERAGE>


10 ICO Satellites at 10355 km, 0 deg elev coverage
90.0
60.0
30.0
0.0
-30.0
-60.0
-90.0
LATITUDE
-180.0
-120.0
-60.0
0.0
60.0
120.0
180.0
LONGITUDE
TIME = 0.0

<Table 2: ACCESS TO TELECOMMS>

Countries	Teledensity (line/100 p)	Urban	Rest/Rural
High income	48.8	51.7	48.5
Upper-mid income	12.9	21.9	10.6
Lower-mid income	8.1	19.0	6.8
Low income	0.9	5.2	0.7

{Source: ITU, World Telecommunication Development Report, 1995}

However, definitions vary depending on countries and regions. In Europe, "the essence of universal service is the access to and the provision of a defined minimum service of specified quality to all users at an affordable price, irrespective of their geographical location"[9], whilst it can be defined as "a telephone within easy reach of all mankind"[10] in many developing countries.

It is necessary to differentiate between 'universal service' and 'regional or global coverage' in the case of GMPCS. Many, not all, regional and global GMPCS systems have technical capabilities to offer their services (see Table 1) anywhere in the world or the relevant regions as illustrated in Figure 4.

However, this does not mean that they are technically capable[11] to provide universal service as defined by countries like those in Europe. GMPCS can offer countries - particularly the developing countries - to help them in achieving the universal service objective as one of telecommunications operators through providing basic or even value-added services with terminals specially tailored to the relevant telecommunications environments and requirements (e.g., village or community fixed payphones etc.).

2.7. Boosting Space & Telecommunications Industry

A growing number of GMPCS systems, ranging from narrowband to broadband, regional to global, and LEOs to GEOs represent not only advancement of the-state-of-the-art technologies, but also growth and convergence of cross-industries such as space, information, broadcasting and communications for both hardware and software.

Compared with the numbers of traditional satellites for GEOs and military purposes, indeed, those of GMPCS to be commercially manufactured, launched and operated throughout the world are enormous: e.g., more than 70 only for Iridium to over 280 for Teledesic.

2.8. Users' Convenience In Globalising Telecommunity

All these, among many others, will give the global telecommunity or village plenty of opportunities through which they can not only participate in such new technological ventures but also improve their telecommunications infrastructures. This will lead to the overall economic development and socio-political well-being (e.g., health, environment, education and even democracy).

Last but not least, it will be, ultimately, the users themselves who will benefit from GMPCS services, depending on their demands. In case of ICO, cellular customers can roam onto the ICO network, when they are outside of cellular coverage either at home or abroad, with a dual-mode ICO mobile phone; the customers in rural and even unserved areas of developing countries will be able to have access to telecommunications service even through tailored telecommunications facilities (e.g., village phones or tele-centre etc.) subject to specific country's needs and environments.

3. Regulatory Challenges of GMPCS

Such socio-economic benefits to be offered by GMPCS can be realised when individual national regulators and competent authorities allow them to provide GMPCS services in their territory.

Then, what are the major regulatory challenges the GMPCS industry faces to provide both the developed and developing world with seamless services ?

3.1. Market Access: Licensing & Authorisation

Each system, first of all, must obtain licence(s) or regulatory authorisation for providing the services using satellites, operation of earth stations, and use of terminals especially at cross-borders.

Licensing has been in tradition one of the policy instruments to introduce evolving technologies and promote competition in the liberalising and privatising telecommunications sectors. However, there is no unified global policy on licensing criteria and policies that exists to date, especially in the era of GMPCS.

That is why the ITU convened its first World Telecommunication Policy Forum (ITU/WTPF, Geneva, in October 1996) on GMPCS, where a simplified, non-discriminatory, and transparent regulatory principle was adopted for service licensing, earth station authorisation, interconnection arrangements, and user terminals[12] .

The ITU has also endeavoured to seek a mechanism to allow use of GMPCS mobile terminals by encouraging Administrations to exempt GMPCS terminals from requiring an individual licence (i.e., requiring only a "blanket" or "class" licence) and permit visitors to use and carry their terminals cross-borders subject to certain rules and conditions[13] .

Moreover, a sort of regulatory guidline on GMPCS[14] , which can be referred to and implemented by national regulators, regional organisations as well as GMPCS-related industries, has been developed by the ITU and will be reported to the ITU World Telecommunication Development Conference (Malta, 1998).

3.2. Frequency Availability & Management

One of the key elements for regulatory authorisation is to have access to the relevant frequency bands (particularly, 1610-2200 MHz), which have been allocated for GMPCS by the ITU.

A critical issue, here, is how to allocate and assign the relevant bands to numerous GMPCS systems in each country. The World Trade Organisation Agreement on Basic Telecommunications Services (WTO/GBT) sets out a framework for non-discrimination and transparency that is applicable in the domain of frequency spectrum and its availability as a scarce global resource. Although some National Regulatory Authorities (NRA's) consider the use of spectrum auctions, the GMPCS industry generally feels that this approach is not consistent with their ability to provide service. Furthermore, such a practice could lead to incompatible spectrum assignment plans which would then eliminate the scope for harmonised regional or global coverage inherent in GMPCS systems. This policy would surely lead to the economic non-viability for GMPCS systems through non-competitive and unattractive end-user charges for GMPCS subscribers in those countries.

Another issue is the potential and in some cases inevitable relocation of services to accommodate new technologies and services: i.e., GMPCS. Certainly, this should be based on technical efficiency so as to cause no interference to the existing or future services, as well as minimal financial implications to all parties involved.

3.3. Ensuring Fair Competition

The success of the WTO/GBT has also provided a more transparent, non-discriminatory, and liberalising regulatory environment that will foster fair competition and provide a level-playing field. Among its central principles is the concept of most favoured nation treatment (MFN) which prohibits Members from discriminating among one another, or in fact from treating other Members less favourably than any other country. Other principles provide competitive safeguards, interconnection, public availability of negotiations for interconnection, transparency of interconnection, public availability of licensing criteria, impartial regulation and the non-discriminatory, timely, objective and transparent allocation and use of scare resources. In the event that Members do not comply to such concepts designed to ensure fair competition, appropriate dispute settlement procedures have been erected.

Similar policies on fair competition are also reflected in the ITU/WTPF, a set of voluntary principles on GMPCS *inter alia*.

Taking into account the development of such regulatory principles and policies at international fora, ensuring open and fair competition at national levels is of significance for GMPCS, since there are or will be plenty of entities providing GMPCS services in the forthcoming 21st Century.

4. Conclusion

GMPCS may not be a panacea to bridge the widening gap of telecommunications infrastructures and capabilities between the developed and developing world.

However, it will certainly contribute to such opportunities as improving lack of telecommunications infrastructures, extending coverage of cellular services, providing various enhanced and speciality services, creating jobs, and fostering industries with a variety of layers of partnership from any part of the world. All in all, GMPCS will play a significant role for the overall socio-economic growth in the global telecommunity.

In consequence, revolutionary changes in the telecommunications sectors - GMPCS *inter alia* - are transforming the global system from a national scale to a web of global interdependence, where every corner of the world is able to be reciprocally interconnected by technologies, networks, and most of all peoples.

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[1] R.O.Keohane, "Reciprocity in international relations", *International Organisations*, Vol.40, No.1., 1986, pp.1-27.

[2] P.A.Reynolds, *An Introduction to International Relations*, London, Longman, 1980, p.274.

[3] Document 14, *Memorandum of Understanding-GMPCS*, ITU, Geneva, 6-7 October 1997.

[4] "ICO and Hughes sign strategic partnership deals", *ICO News Release*, London, October 5 1995.

[5] "NEC-led consortium to build ICO's global ground network infrastructure", *ICO News Release*, London, March 3 1997.

[6] Ian Verchere, "many roads to many markets", *ICO Magazine*, Issue 3, London, 1997, p.8.

[7] "The ICO Partnership", A supplement to *Via Satellite*, September 1997,p.8.

[8] *Universal service for telecommunications in the perspective of a fully liberalised environment: communication from the European Commission*. COM (96) 73, Brussels, March 13 1996, p.16. Also see "Chair's Conclusions", *Information Society and Development Conference*, South Africa, May 13-15 1996.

[9] *Proposal for a Council Resolution on universal service principles in the telecommunications sector*, COM (93) 543 final, Brussels, November 15 1993, p.15.

[10] *The Missing Link*, ITU, Geneva, December 1984, p.5.

[11] See limited channel capacity of each system in Table 1.

[12] "Chairman's Report: Policy and regulatory issues raised by the introduction of GMPCS", WTPF, Geneva, October 21-23 1996.

[13] "Memorandum of Understanding to facilitate Arrangements for GMPCS including regional system", ITU, Geneva, February 1997 & "Arrangements pursuant to the GMPCS-MoU", ITU, Geneva, October 6-7 1997.

[14] The Expert Group established by Opinion 5 of the ITU/WTPF has undertaken studies on GMPCS and produced a checklist and a report based on five Regional Workshops on various issues of GMPCS.

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The National Information Infrastructure in the Asia-Pacific Region

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1. ABSTRACT

The paper examines the development of National Information Infrastructure (NII) policies in the Asia-Pacific region in the context of the overall globalization of these industries and these countries' goals of improving their economic development and international competitiveness. It gives particular attention to the differential responses in Asia-Pacific countries to globalization developments in the telecommunications and broadcasting industries. The nature of competition and cooperation (strategic alliances) between firms and the implications of convergence between telecommunications and broadcasting industries are considered.

2. INTRODUCTION

Many countries in the Asia-Pacific region have experienced phenomenal economic growth over the past thirty years. These countries have shifted into more sophisticated manufacturing and service industries following the lead of Japan. Information, computer and telecommunications (ICTs) industries have also become more significant. The implementation of National Information Infrastructures (NII) by Asia-Pacific countries represents a recognition by governments of the importance of ICT technologies and the need to coordinate their introduction. While most countries have focused on planning at a national scale, Asia-Pacific countries are also part of moves to promote a Global Information Infrastructure (GII).

The rise in the importance of ICT technologies reflects rapid technological advances which has lowered costs and increased the range of applications. In addition, considerable convergence of these technologies is taking place, reflecting the increasing role of digital technologies. While adoption of ICTs in the Asia-Pacific region lags behind Western industrialized countries, organizations and individuals throughout the region are using them more intensively (Arnold 1997). Governments of Asia-Pacific countries have recognized the importance of maximizing adoption of ICT technologies and see the NII is an important part of their goal of improving their countries' international competitiveness.

The purpose of this paper is to examine the adoption of new ICT technologies in the NII by selected Asia-Pacific countries in the context of the globalization of these industries and the countries' goals of improving their economic development and international competitiveness. Policy and commercial interest in these technologies in the region has been stimulated by rapid technological change and the central role of these industries in Western industrialized countries. They also perceive that they will not be competitive in low wage industries that have been the bases of their early growth and recognize that they must shift into high technology industries. The nature of Asia-Pacific countries' NIIs is being shaped by the complex competitive and cooperative relationships between these countries in ICT technologies and in high-technology industries in general.

The perceived social and economic importance of these technologies has resulted in many governments' according them a high policy priority. Competition between Western industrialized countries to be at the forefront in the adoption of new ICT technologies has meant that governments are encouraging rapid innovation in this area. This competitive environment is also very important in the Asia-Pacific region, with developed economies (Japan, Singapore, South Korea and Taiwan) viewing the promotion of ICT technologies as central to their long-term economic growth. In addition, near-Newly Industrializing Economies (NIEs) (e.g., Malaysia, Thailand and the Philippines) have targetted these technologies. Asia-Pacific countries also see these technologies as contributing to social goals, but these tend to be of secondary importance.

2.1 Globalization

Globalization is a key development shaping countries' economies and is having major economic, social and political ramifications (UNCTAD 1995). It is being driven by such factors as rapid technological change, particularly in ICT technologies, and the liberalization of trade and foreign direct investment. However, the role of globalization should not be overestimated. While global forces are playing a more prominent role in shaping industrial growth, complex interdependencies exist between processes operating at geographical scales ranging from the global to the local.

Globalization processes are a significant force in shaping the implementation of the NII in countries in the Asia-Pacific region. This is partly the result of the rising importance of major transnational corporations (TNCs) throughout the region in ICT technologies. Furthermore, these firms are forming strategic alliances with other TNCs and with national firms.

The operations of TNCs represent an important component of globalization. Major TNCs from the U.S. and Europe have expanded their production activities in the Asia-Pacific region from the 1960s in electronics and other high-technology industries. More recently, TNCs in telecommunications, broadcasting and multimedia industries have entered the region, although the extent of their operations are circumscribed by government regulation (Langdale, 1997a,b,c). At the same time, complex trade, foreign direct investment and other linkages have emerged within the region. Thus the Asia-Pacific region exhibits a growing range of linkages at global, regional and national levels. The level of economic development and technological sophistication of countries in the region is also rising rapidly, further contributing to a complex global and regional division of production (Simon and Yun 1995).

Strategic alliances are playing a more important role in globalization in recent years, particularly in high-technology industries (Gugler and Dunning 1993; OECD 1991). They are very important in ICT industries. The reasons for their growth include such factors as increased international competition in industries, rapidly escalating R&D costs and growing technological convergence in information industries. In addition, many states play a critical role in limiting entry of foreign firms into their countries and encouraging formation of joint ventures with domestic firms (Office of Technology Assessment 1993; National Research Council 1996). These alliances are important Asia-Pacific countries' NII plans, because it is increasingly necessary for ICT policies to recognize the role of the global transfer of technology.

2.2 National and Global Information Infrastructure

The NII is envisaged to have a central role in transforming the economies of industrialized countries. The U.S. and other industrialised countries are shifting into knowledge-based societies; national well-being and international competitiveness will depend on the speed with which knowledge is created and the ease with which people are able to access it. Many governments are attempting to encourage the creation of a national information and communications network using broadband telecommunications to connect homes and businesses as well as public institutions such as schools and hospitals (U.S. Department of Commerce 1994).

The GII is an international extension of the NII concept. The GII will allow countries to share information and to communicate as a global community (U.S. Office of the Vice President 1995). The U.S. argued that these connections will facilitate economic progress, enhance democratic trends in countries and provide better solutions to global environmental challenges. The plan is based on five principles: encouragement of private investment; promotion of competition; creation of a flexible regulatory framework that can keep pace with rapid technological and market changes; provision of open access to the network for all information providers; and ensuring the provision of universal service.

A number of Asia-Pacific cooperative multimedia plans are being developed. Member countries of the Asia Pacific Economic Cooperation (APEC) are planning to develop an Asia-Pacific Information Infrastructure (APII) to facilitate regional information exchange. The success of such a network partly depends on the extent of cooperation among countries in the region, but also on the number of countries that successfully implement their own NIIs. In addition, a number of Asian countries are cooperating in the Asian Multimedia Forum in developing multimedia applications: participants include firms from Japan, Hong Kong, South Korea, the Philippines, Thailand, Malaysia and Singapore.

3. NATIONAL INFORMATION INFRASTRUCTURE IN THE ASIA-PACIFIC REGION

While Asia-Pacific countries are facing common opportunities and threats in their NII development from globalization and regionalization trends, each is unique in its particular situation (Langdale 1997a,b,c). The diversity of national responses to global and regional forces depends on such factors as the country's level of technological and economic development and the nature of government intervention. Clearly, implementation of an NII strategy for an industrialized country such as Japan is very different from that for a large developing country such as China.

While generalizations are difficult in Asia-Pacific region, three broad categories of countries may be recognized. Firstly, Northeast Asian economies (Japan, South Korea and Taiwan) with large export-oriented electronics industries have developed NII policies, partly because it would be difficult for their telecommunications and information equipment firms to be internationally competitive without a large innovative domestic market. A second group are regionally-oriented economies (Singapore and Hong Kong) which have NII policies facilitating their regional headquarters' role for foreign ICT companies. However, these cities are facing growing competition from other regional cities (e.g., Kuala Lumpur, Sydney and Taipei) which are expanding their regional services role. The third group includes a diverse set of countries, but ranges from the near-Newly Industrializing Economies (NIEs) such as Thailand and Malaysia to poorer ones such as China. In general, the teledensity (the number of telephones per hundred population) in these countries is very low and the central telecommunications issue is expanding basic telephony services throughout the country. However, they also want to promote economic growth in their major cities and advanced telecommunications services are seen as central to this national goal.

3.1 Northeast Asian countries

The international competitiveness of information equipment industries in the Northeast Asian economies of Japan, Taiwan and South Korea is an important factor underpinning their expansion in ICT technologies. Major information equipment companies, such as Sony, Toshiba and Fujitsu from Japan and Samsung and Daewoo from South Korea, are using their technological expertise in semiconductor and consumer electronics industries to develop new markets in ICT equipment and services. These countries have been concerned about the "hollowing out" of their manufacturing base, as ICT firms pursue globalization strategies which entail expansion of manufacturing operations in Western industrialized countries (U.S. and Western Europe) and also to low-wage East Asian countries. In part, the governments' NII policies represent a desire to facilitate major economic restructuring of their economies and to take advantage of opportunities in new high growth ICT equipment and service industries.

Japanese developments in telecommunications and multimedia technologies are of particular importance given Japan's international competitive strength in ICT industries. The U.S. government's NII plan has attracted major interest from both Japanese firms and the government worried about the competitive threat to Japanese industry, although some groups in Japan exaggerated the U.S. threat in order to bring about a more unified Japanese response (West 1996; West, Dedrick and Kraemer 1997). The Japanese government has given the development of ICT technologies a high priority. A report to the Ministry of Posts and Telecommunications (MPT) argued that Japan needed to expand information-based industries and that a nationwide fibre optic network should be a core component of Japan's new information society (Telecommunications Council 1994).

However, the development of an NII in Japan is complicated by a number of factors. One is that there is continuing uncertainty over Japanese telecommunications policy. Under an agreement between NTT and the MPT announced in 1996, NTT is to be divided into a long-distance company and two local telephone companies, wholly owned by a holding company. However, it is not clear how much competition will be stimulated by this agreement (Oguwa 1996). A second factor is that the introduction of these technologies is influenced by on-going 'turf wars' between government departments, particularly the MPT and the Ministry of International Trade and Industry (MITI) (Morris-Suzuki 1989). Both ministries are attempting to take control of the NII policy agenda. Thirdly, little attention has been paid to the likely demand in the home for broadband services. It has been proposed that the NII would provide fibre to the home by 2010, although it is uncertain what consumer demand exists for broadband services.

South Korea and Taiwan have strong ICT equipment industries and in some areas are technologically comparable with Japan (Sharma 1995). The Korean and Taiwanese governments are playing a prominent role in building nationwide fibre optic networks in their respective countries, although private enterprise in Taiwan is also developing a number of network products and services.

Both Korea and Taiwan are liberalizing their telecommunications industries as part of their NII plans and in response to international deregulatory pressure, although it is unlikely that competitors will make a significant impact on the market dominance of the former monopoly carrier in each country for some time. Foreign carriers are unlikely to occupy a major role, even though under pressure from the U.S. government and liberalization moves in the WTO, both governments have allowed additional foreign equity in telecommunications carriers: Korea and Taiwan will allow up to 49% foreign equity by 2001.

In 1997 an NII Taskforce of the Taiwanese government advocated that Taiwan should focus on a number of projects. These included advanced telecommunications network construction; integration of cable television and telecommunications; education, government and health applications; and electronic payment systems. Similarly, the Korean government released a report in mid-1997 on the NII which aimed to make Korea one of the world's top five IT countries in the next decade. The plan focuses on both the supply and demand side of the NII. On the supply side, particular attention was given to the rapid development of ICT technologies, while on the demand side such applications as education, electronic currency and new databases in arts and culture were envisaged (*Taiwan Business News*, 1997; Yu 1997).

A central policy goal of the Taiwanese and Korean governments is that they have to accelerate the shift of their respective economies into high-technology industries. Both economies face the problem of expanding higher value-added manufacturing, given the relocation of low-wage production offshore. The rapid increase in domestic labour costs in Korea and Taiwan is leading to low wage assembly-type operations shifting offshore to cheaper locations in Southeast Asia and China (Tyson 1995). For example, Taiwanese companies manufactured over US$5.3 billion worth of IT equipment in low-wage countries in 1996. The offshore shift is expanding, with overseas production of Taiwanese information technology firms increasing 75 percent in 1994-95 (*East Asian Executive Reports* 1996).

Another factor underpinning Taiwan's development of a NII is its desire to develop as a regional services centre. Taiwan has implemented an Asia-Pacific Regional Operations Centre (APROC) strategy for technology-intensive manufacturing, air and sea trans-shipment, finance, telecommunications and media industries (Engbarth 1995; Shapiro 1995). A world-class NII is necessary to enhance Taiwan's international competitiveness in its APROC strategy. The partial deregulation of the telecommunications industry and the government's approval of the entry of foreign carriers (albeit in a minority equity position) is a major component of this strategy. However, the slow pace of these changes and the lack of internationally competitive service industries means that Taiwan is unlikely to pose a major competitive threat to Singapore and Hong Kong in regional services activities.

3.2 Regional hubs: Singapore and Hong Kong

Singapore and Hong Kong are the dominant regional services cities in the Asia-Pacific region. Both have major regionally-oriented industries in banking and finance and freight and passenger transportation and have attracted regional headquarters (RHQs) of major firms operating in the region (Raguramanm 1997; van der Knapp and Smits 1997). The traditional rivalry between the two cities has expanded in recent years to include information-based industries, such as communications satellite uplinking, film and video production and regional telecommunications hubs for large firms. ICT technologies are a central component of both cities' current and future global and regional competitiveness.

Hong Kong's regional role has been affected by its high cost structure; office rents and labour costs are among the highest in Asia and some firms have relocated part or all of their operations to other Asia-Pacific cities to reduce costs (*Business Asia* 1994). However, it is the traditional hub of offshore business in East Asia and has strong regionally-oriented banking and finance, telecommunications and transport industries. Furthermore, close economic and cultural linkages with the booming southern China region have given its economy a major boost.

Competition is likely to emerge between Hongkong Telecom and Wharf Cable, the cable television operator, in the interactive cable television market. Hongkong Telecom plans to start an interactive service in 1997, which will provide video-on-demand as well as banking, retail, information and community services. Wharf Cable is providing a conventional cable television service at present, but expansion of its hybrid fibre and coaxial cable network to homes will provide it with the capability of providing telephony and multimedia services in the future. In addition, a new entrant plans to provide video-on-demand services: the consortium includes such firms as New World (an affiliate of Hutchison Whampoa), Mei Ah International (Hong Kong-listed Chinese-language video distributor) and film producer Win's Movie Investment (Najberg and Stein 1997). Hong Kong is an ideal location for introducing video-on-demand given its dense population and wealth. However, it is unlikely that demand for these new services will be very large at least for the next five years.

Singapore is also a major hub for regional services in the Asia-Pacific region. The Singapore government has targetted telecommunications, broadcasting and information technology industries as being critical to enhance its global and regional role; the development of a world-class telecommunications infrastructure is a very high national priority. New telecommunications and multimedia technologies are important for the Singapore government's long-term international competitiveness plans. The government has accelerated the entry of competition in telecommunications in order to boost the country's ICT development. Fibre optic networks are being built by Singapore Telecom and Singapore Cablevision. Furthermore, Singapore Telecom currently faces competition in mobile communications and will have competition in other services by 2000.

The government plans to attract foreign multimedia firms on the basis of two complementary policies. Firstly, the government is promoting the country as an innovative multimedia market. A fibre-optic cable infrastructure will be completed by 2000 and the government is rapidly introducing multimedia technologies in schools, colleges and government offices as a part of its IT plan.

The government is introducing an information network, Singapore One, a project designed to promote IT in Singapore and provide a wide range of public and private information to households. It will provide high bandwidth applications for data, voice and graphics. A number of domestic and foreign firms are providing services to households, some for a fee. The Singapore government is heavily involved in the project, but has been criticized for subsidizing U.S. multimedia companies' market trials (McDermott 1997b). However, the counter argument is that consumers will not subscribe to multimedia services unless there is a wide range of content available to them.

The government is also encouraging foreign firms to locate in Singapore to help design and provide software. Singapore's strengths are its very well-developed business infrastructure, excellent transport and communications networks and pro-business attitude of the government. A difficulty with its ICT strategy is that other developed East Asian countries are moving quickly to develop these industries and have the attraction of much bigger domestic markets. Malaysia's Multimedia Super Corridor, in particular, represents a competitive threat. In addition, costs for office space and labour are rising rapidly in Singapore and severe skilled labour shortages present a growing problem.

The second and complementary part of the government's strategy is to encourage foreign multimedia firms to use Singapore as the RHQ for their expansion in Southeast Asian multimedia markets. Singapore's attraction for these RHQs is its overall efficient business operations. It already serves as a base for satellite uplinking, media financing and post-production services (Lim 1994) and has achieved some success in attracting a number of foreign multimedia production firms.

3.3 Near-Newly Industrializing Economies

While most NII activity has taken place in developed Asia-Pacific countries, significant developments are taking place in other Asian countries as well. However, other issues such as the low level of telecommunications development as well as the introduction of competition and privatization of telecommunications carriers have been of greater policy importance. These countries currently have very low teledensities, although a rapid expansion is projected in the future.

Introduction of the NII raises a policy dilemma in the delivery of telecommunications services for many countries. On the one hand, less developed Asia-Pacific countries' governments want to expand the geographical coverage of the telephone network to all citizens (the universal service goal), while at the same time introducing advanced business telecommunications services in major cities in order to enhance firms' connections to global information networks. Despite the avowed adoption of universal service principles by many countries, non-metropolitan areas in Asia-Pacific countries are poorly provided with telephony services. In general, telephone penetration rates are much lower outside major cities. The teledensity in Thailand, for example, is projected to rise from 8.6 in 1995 to 18.4 in 2001. However, most of the lines are likely to be in Bangkok: the teledensity in Bangkok is projected to rise from 39 in 1993 to 56 in 2001, whereas the rest of the country will still have low teledensity levels, rising from 3.4 in 1995 to 11.7 in 2001 (Durongkaveroj 1996).

New telecommunications and multimedia services are usually introduced in major cities. However, extension of the universal service principle to broadband services would be prohibitively expensive at a stage when demand for them is in its infancy. Furthermore, cross-subsidization from city to rural subscribers would discourage overall adoption levels and make the services economically unviable. On the other hand, if these services are as important to society as many have argued, then the lack of access for people living in non-metropolitan regions reinforces existing regional inequalities.

Countries which are moving towards developed status such as Malaysia and Thailand are expanding their usage of ICT technologies. While their strategies in these technologies areas are still being developed, ICT technologies are central to these countries' overall development. However, the situation is complicated by the rapid restructuring taking place in telecommunications.

I focus here on NII developments in Malaysia. Malaysia is introducing more competition in telecommunications, allowing limited entry of foreign carriers, and has partially privatized Telekom Malaysia. US West, the large U.S. telecommunications carrier, has a 20% shareholding in Binariang, the largest Malaysian competitive carrier. The Malaysian company was interested in accessing the multimedia expertise of the U.S. company. Telekom Malaysia is planning to develop a national broadband network to support multimedia applications. The government argues that Malaysia needs to have telecommunications services comparable to those of other industrialized countries.

Malaysia is developing a Multimedia Super Corridor (MSC) linking Kuala Lumpur with the new administrative capital, Putrajaya, and the new international airport. Details of the MSC are fairly general at present, but include a futuristic city, a multi-billion dollar test bed wired with the latest technology. Fibre optic cables will connect activities within the MSC and provides links to international high-technology centres. The government will provide tax concessions to approved multimedia companies and allow foreign firms to bring in skilled foreign workers, although shortages of skilled labour may provide a significant long-term problem for the corridor (*Economist* 1997). There is considerable uncertainty about the viability of the project, with a major problem of reconciling Western ideas in a traditional, mostly Islamic society with pervasive censorship. Internet access will not be censored in the MSC while it is in the rest of Malaysia (Wysocki 1997). In many respects the MSC may be seen as competing with Singapore's ICT plans: both countries are aiming to attract foreign TNCs in global and regional ICT technologies.

4. CONCLUSIONS

A central problem for Asia-Pacific countries in formulating NII policies is that most have targetted similar activities. Furthermore, they have followed Western industrialized countries in their pursuit of the NII and face strong competition from them. Clearly, not all countries will succeed in these industries (O'Connor 1995). Asia-Pacific countries need to focus their NII policies on addressing the particular social and economic problems facing their countries. Furthermore, the direction of each country's NII needs to focus on the country's existing and potential international competitive strengths.

The direction of NII policies in Singapore and Hong Kong is clear, since both are major regional services centres for the Asia-Pacific region. The Singapore government, in particular, has policies in such industries as banking and finance, transportation (e.g., world class facilities for Changi Airport and the port) and telecommunications which reinforce its regional and global city role. While Hong Kong's role in the Asia-Pacific region as a headquarters location for the booming southern China region is well established, it is not clear what the government's ICT policy will be in the future.

The situation in other countries is less clear, partly because of multiple and often conflicting policy goals. A number of Northeast Asian economies have focused on the NII to provide an innovative market for equipment manufacturers in new ICT technologies. However, the emergence of an NII strategy in Japan is partly related to economic and social goals, but also to the bureaucratic conflicts between Japanese government departments, particularly the MPT and MITI. While the Korean and Taiwanese NII plans have paid more attention to supply-side considerations recently, it is not clear how much attention has been given to what consumers actually want from the NII.

5. REFERENCES

Arnold, Wayne 1997 Technology in Asia: Not quite clicking, *Asian Wall St Journal*, 1 Aug., 1, 4.

Asian Wall St Journal 1995 US West enters media venture with Binariang, 27 Feb. 22.

Business Asia 1994 Costs: the tale of two cities, 23 May, 1-3.

Durongkaveroj, Pichet 1996 Information technology development in Thailand, Unpublished paper presented to a Workshop on Exploring Electronic Space, Hikone, Japan, May.

East Asian Executive Reports 1996 Moving up in the world of information technology, 18(3): 22-24.

Economist 1997 Virtually fantastic, 1 Mar., 75-6.

Engbarth, Dennis 1995 Taipei taps Asia-Pacific, *The Banker*, 145(828): 56-59.

Gugler, P and Dunning, J 1993 'Technology-based cross-border alliances' in Culpan, R (ed.), *Multinational Strategic Alliances*, International Business Press, New York (1993) 123-65.

Langdale, John V. 1997a 'Globalisation or regionalisation? Telecommunications and interactive multimedia in East Asia' in *Pacific Rim Development: Integration and Globalisation in the Asia-Pacific Economy*, Rimmer, Peter (ed.) Sydney: Allen and Unwin, 115-29.

Langdale, John V. 1997b International competitiveness in East Asia: Broadband telecommunications and interactive multimedia, *Telecommunications Policy*, 21(3), 1997, 235-249.

Langdale, John V. 1997c East Asian broadcasting industries: Global, regional and national perspectives, *Economic Geography*, 73(3), 305-321.

Lim, S. 1994 Singapore, *Movie/TV Marketing*, 25 July, 11.

McDermott, Darren 1997a Singapore allows 2 bidders to enter telecom market, *Asian Wall St Journal*, 20 Jan., 3.

McDermott, Darren 1997b Singapore, *Asian Wall St Journal*, 10 June, S18.

Morris-Suzuki, T. 1989 *Beyond Computopia: Information, Automation and Democracy in Japan* , Keegan Paul, London.

Najberg, Adam and Stein, Peter 1997 Home-video services race in Hong Kong intensifies, *Asian Wall St Journal*, 11 Mar., 22.

National Research Council 1996 *Conflict and Cooperation in National Competition for High Technology Industry*, Washington, D.C.: National Academy Press, Committee on International Friction and Cooperation in High Technology Development.

O'Connor, David C. 1995 'Technology and industrial development in the Asian NIEs: Past performance and future prospects' in *The Emerging Technological Trajectory of the Pacific Rim*, Simon, Denis F. (ed.), Armonk, New York: M.E. Sharpe, 55-80.

OECD 1991 *Technology in a Changing World*, Paris, 113-136.

Office of Technology Assessment 1993 *Multinationals and the National Interest: Playing by*

Different Rules U.S. Congress, Office of Technology, Washington, D.C. 116.

Oguwa, Joshua 1996 Restructuring would put NTT into hot global arena, *Nikkei Weekly*, 9 Dec., 1.

Raguramanm K. 1997 International air cargo hubbing: The case of Singapore, *Asia-Pacific Viewpoint*, 38(1), 55-74.

Shapiro, D. 1995 Transforming Taiwan *Asian Business* , 31(4), 24-28.

Sharma, R. 1995 "Infobahns" in Asia: Promises and perils *IEEE Multimedia* 2(2) 80-5.

Simon, D F and Yun, Y 1995 'Technological change, foreign investment and the new strategic thrust of Japanese firms in the Asia Pacific' in Chen, E K Y and Drysdale, P (eds)*Corporate Links and Foreign Direct Investment in Asia and the Pacific*, HarperEducational, Pymble, 203-26.

Taiwan Business News 1997 NII taskforce outlines four-year plan, 6 June.

Telecommunications Council 1994 *Reforms toward the Intellectually Creative Society of the 21st Century* Ministry of Posts and Telecommunications, Tokyo.

Tyson, Laura 1995 Adventurous investors with plenty of cash, *Asiamoney*, (Taiwan Supplement): 36-39.

UNCTAD 1995 *World Investment Report 1995: Transnational Corporations and Competitiveness*, United Nations Conference on Trade and Development. Programme on Transnational Corporations, New York: United Nations Publications.

U.S. Department of Commerce 1994 *Competing to Win in a Global Economy*, Washington, D.C., 64.

U.S. Office of the Vice President 1995 *The Global Information Infrastructure: Agenda for Cooperation* U.S. Government Publishing Office, Washington, D.C.

van der Knapp, Bert and Smits, Gert-Jan 1997 Hong Kong's industrial structure and growth of advanced business services, *Tijdschift voor Economische en Sociale Geografie*, 88(1), 3-14.

West, Joel 1996 Utopian and national competitiveness in technology rhetoric: The case of Japan's information infrastructure, *Information Society*, 12(3), 251-272.

West, J. Dedrick, J. and Kraemer, K. 1997 'Back to the future: Japan's NII plans' in *National Information Infrastructure Initiatives: Vision and Policy Design*, Brian Kahin and Ernest J. Wilson (eds.) Cambridge, MA : MIT Press.

Wysocki, Bernard 1997 Malaysia builds its own Silicon Valley, *Asian Wall St Journal*, 11 June, 1, 8.

Yu Kun-ha 1997 Government to develop Korea into a top information-technology power, *The Korean Herald*, 4 June.

Zarit, W. 1995 Taiwan mapping out plans to build the superhighway to its information future, *East Asian Executive Reports* , 17(1), 8,15+.

National Sovereignty and the Regulation of Transnational Information Flow: An Asian Perspective

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Abstract

As the global community is entering into the twenty-first century,regulating one of the most important forms of global communication, i.e., network communication, has become an increasingly complicated issue.

While reasons for taking a "hands-off" policy regarding network communications are not difficult to find from either the technological, legal, or political perspective, governments around the world have begun to take moves toward the opposit direction. Especially worthy of notice are measures adopted by two Asian nations, i.e, China and Singapore.

Whether the measures work will undoubtedly have significant and long-lasting influence on the future of network communication. But equally, if not more, important, is the rationale behind the governments' unwavered stance in regulating the medium.

It is the purpose of this paper to look at the difficulties in regulating transnational information flow over computer networks, and the reasons why governments chose to undertake this almost impossible task. Using Singapore and China as examples, the paper examined the effectiveness of policy measures adopted by these two nations, and the rationale of such measures in relation to the concept of national sovereignty.

Regulating Network Communication: Legal Barriers

From a legal perspective, regulating network communication is complicated partly because of the nature of the medium. In the past different models were used to regulate media of different nature. Regulation of the electronic media was based on the principle of spectrum scarcity, and that of cable television on economic scarcity. Although telephone might have features similar to that of computer networks, it was traditioanlly regulated as a common carrier, not as a common carrier and content provider (Liu, 1996).

When computer networks emerged as a powerful means of communication, policy makers found themselves faced with a new challenge. Because there was no spectrum or economic scarcity involved for computer networks, regulatory models for electronic media and cable television did not apply; and because it provided information content and various other types of online services, the telephone model was out of the question. Any attempt to regulate network communication, therefore, would require a whole new approach which was not likely to come by quickly (Liu, 1996).

One other major obstacle in the way of regulating network communication was the jurisdictional quandary faced by governments in dealing with a medium that allows vast volume of information to flow across national borders in split seconds. As the network is decentralized and anarchical in nature, problem came when regulations in one nation conflicted with that in others.

One case in point involved financial data at the Bank of Nova Scotia, a multinational bank with more than 1,200 branches in forty-six countries (Branscomb, 1993). The Canadian Bank was faced with an impossible situation when its Miami branch was subpoenaed by a U.S. federal district court to release financial data in subsidiary banks in Bahamas and Cayman Island, while laws in these nations prohibited disclosure of such information. The case illustrated the necessity of close international cooperation before any effort in regulating network communication could be truly fruitful.

The Free Flow Principle

Despite the difficulties involved in regulating network communication, it did not cause a great deal of concern to policy makers in majority of the Western nations, at least not in its initial stage of development. These nations, with a long tradition of honoring the ideal of free flow of information, chose to take a non-interventionist approach regarding information flow across national borders, even when transborder data flow raised concerns over individual privacy and intellectual property rights (Drake, 1993).

In addition to the time-honored tradition, there are more reasons for keeping information flow over the networks free from government regulations. Computer networks may not be the only means of communication that allows for information to be freely disseminated, by-passing government controls; yet throughout human history societies have not seen a medium that is better capable in realising the spirit of freedom of information at the scale and the scope that Internet has achieved.

By nature network communication is open, democratic and interactive, thus allowing for almost complete freedom in the exchanges of information and ideas. The imposition of limits and restrictions on such a form of communication, therefore, is not only violating the free flow principle, but is running the risk of jeopardizing a medium which is capable of making freedom of communication a reality.

However despite the above considerations, recent events in Europe and North America seemed to indicate a change in the non-interventionist approach. What brought the change was the increasing supply of pornographic materials over the networks. While freedom of communication remained to be highly valued and new regulatory model yet developed, political leaders were beginning to feel the need to exercise a certain degree of control to filter out materials harmful to the younger generation.

The greatest challenge in carrying out the task, therefore, was for the government to walk the fine line between freedom of information and protection of the young within the existing legal framework. The German government's request for Compuserve to block users from accessing 200 of its newsgroups, and U.S. supreme court ruling the Communications Decency Act a violation of the First Amendment were two notable examples of the plight faced by policy makers.

Regulating the Net: Two Pioneers

While the U.S. supreme court decided to guard against legislations that might hamper the freedom of speech, in countries that had traditionally put other values above such freedom, the question was not whether to regulate information flow over the Internet, but how.

This differences in policy attitude, coming from an entirely different way of looking at information freedom, is especially pronounced in two nations in the Asia Pacific: China and Singapore. In both countries governments have taken specific steps to control information flow over computer networks:

1. China

The first step the Chinese government took to ensure safety on the net was self-censorship by service providers. China Internet, the largest Internet linkup-service provider in China, announced in 1995 that the company prohibited any "pornographic or political material, or Western decadent culture" to go on its network. Similar measures were taken by the government-owned ChinaNet.

On February 1 1996, China's State Department unveiled a "Tentative Regulation on the Management of Chinese Computer Networks and International Networks," stipulating that all linkages with international networks must go through the Ministry of Post and Telecommunications or three other government departments. In addition the regulation specified that any attempt to post, copy, disseminate or even browse information that is "harmful to public security" would be penalized (Huang, 1997).

To further strengthen government control over network uses, two weeks later China's Public Security Department issued another decree, requesting all users of international computer networks to report to its offices within 30 days. Users were asked to sign an agreement in which the signatory guaranteed that he or she would not do harm to the nation or commit crimes by using the networks.

The purpose of these rules and regulations, according to a Chinese officer in charge of computer management, was to prevent criminal behaviors and to prevent the spread of harmful information (Huang, 1997).

As a demonstration of its determination, the Chinese government blocked access to 100 sites on the World Wide Web in September 1996. Banned were sites run by American newspapers, Tibetan exiles, the Taiwanese government, Playboy and The Economist (Millard, 1997; The Economist, September 14, 1996). The list covered all of what the government promised to keep out of the net: pornographic materials, "Western decadent cultures" and information with political implications, e.g., sites run by the Taiwan government and Tibetan exiles.

2. Singapore

Regulations on network communications came into effect on July 15, 1996 in Singapore (Millard, 1997). According to the Singapore Broadcasting Authority Class Licence Notification 1996, computer online services constituted licensable broadcasting services, therefore were subject to the class licence.

Under the above regulations, ISP (Internet service provider) licensees and content providers must register with SBA and comply with the SBA Internet Content Guidelines which specifically bannedthree types of information:

1) Information that jeopardizes public security or national defense, including contents which undermine the public confidence in the administration of justice, mislead the public, or bring the government into hatred or contempt.

2) Information that disturbs racial and religious harmony, including contents that promote religious deviation or occult practices.

3) Information that denigrates public morals, such as pornographic, violent materials or contents that deal with sexual perversions such as homosexuality.

In addition ISPs must assist SBA investigations into any alleged violations of law and ensure that their services are not used for purposes, or contain programs that are "against public interest, public order or national harmony," or "offends against good taste or decency."

Under the regulatory design, the ISPs are regulated by SBA, but the responsiblity in censoring content is in effect placed on the providers. To ensure that ISPs comply with the new laws, they were asked to install "proxy servers," a large-capacity computer that is capable of blocking access to sites banned by SBA.

In the few months after the regulation came into effect, the news media and networks were reporting cases that invoked ISP or SBA actions. A newsgroup that posted criticism of some lawyers was blocked by its ISP, a man was fined $61,500 for using the Internet for pornographic purposes, and the homepage of a 19- year-old youth was terminated for posting jokes on the Malays.

Reactions to China and Singapore's efforts in regulating Internet uses were either critical, cynical, or both. Cynical because the nature of the network makes any form of information control extremely difficult.

Punishment in the form of legal sentences or political persecution used to be one of government's most powerful weapons in intimidating attempts to disseminate information it disapproved. However for network communication, the origin of information is all-too-frequently outside of the jurisdiction of a national government. Governments may hold local gatekeepers, i.e., content and service providers responsible for the information flowing over the networks, however the speed and volume of information transmitted and the spontaneity and interactivity of the system have turned network information a "moving target" for censorship, whether carried out by government agencies or by the gatekeepers.

Both the Chinese and the Singapore governments have taken actions to ban Web sites. But with countless number of sites appearing and disappearing daily over the networks, it is questionable whether banning a few dozens, or a few hundred sites could solve the problem. As an article in Singapore's Strait Times Forum suggested, rather than taking the trouble of filtering out unacceptable sites itself, it would probably be easier for SBA to use software packages such as NetNanny which automatically blocks access to several thousands sites.

While the effectiveness of the measures was questionable, the intention of the government stirred criticism. It was pointed out that not only the prohibited content categories covered topic areas much wider than pornography, their definition was subject to interpretation by the gatekeepers and law enforcement officers. Although SBA insisted that all sites banned were pornography, that it was not involved in the decision to block the newsgroup that criticized lawyers or that the government could still be criticized, there were suggestions that it was the ruling party's intention to restrict free speech by banning information that tended to "bring the government into hatred or contempt."

Also criticized wasmaking ISPs responsible inassisting SBA investigation in any alleged violation of law. What the regulation implied wasthat in the name of the law, the government could look into any user's activity over the networks, including information accesses, message exchanges, and business and financial transactions. To those who were concerned about individual privacy, the stipulation was an added blow to the already frail protection of network users' rights.

Policy Rationale

In the eyes of many, regulating the networks means fighting against the current; nothing needs, or should be done unless it is matters of grave concern, e.g., the surge of pornographic material. However not all read the attempts China and Singapore made the same way, especially nations that have a long tradition of guarding against media content that is perceived to be potentially harmful to social harmony, or to political stability.

After pornography sites were blocked in Singapore, an article in Hong Kong's South China Morning Post (September 20, 1996) wrote:

"...its [Singapore's] experiment in taming the net will be closely watched by government around the world, but particularly so in Asia, where many politicians are nervous of the nature of the web, which they criticise as a polluting influences, full of decadent Western values."

In many Asian nations, therefore, concerns over free access to the Internet are caused not just by sex or violence in the materials that are made available through the networks. When democracy has yet been fully materialized and memories of racial conflicts or colonial rule still fresh, ideals such as freedom of information would hardly be viewed as important as social harmony, political stability or economic growth. Leaving network communication entirely unregulated not only raises concerns that it may allow Western influences to flood in, but may also bring in politically or ethnically sensitive materials that would disturb a very delicate, fragile social system.

All factors considered, the need to regulate network communication is much the same as the need to regulate any other media. As Singapore's Minister of Information George Yeo put it, "...laws of the land must apply as much in cyberspace as they do in real world" (transcript of BBC interview, September 15, 1996).

Others who take an even broader perspective may regard regulating network communication as simply a matter of gaining control of what is happening within a nation's territory. The attitude is clearly spelled out in a statement made by China's Minister of Post and Telecommunications after ISPs in China announced that self-censorship would be exercised: "China as a sovereign state is putting this type of information under control (Huang, 1997, Lange, 1995)."

A Matter of Sovereignty

Since the late 1980s, "globalization" has become a prevailing concept in the business, political and also academic community. As Hamelink (1993) pointed out, beginning with the concerns for global climate change due to the greenhouse effect, our world has embarked on a globalization process, thanks toat least five driving forces: technological innovations, military security and environmental conservation, the need for justice, financial market operations and growth of trade.

In contrast to this rising globalism is the perceived decline of the power of the nation state and national sovereignty. As increasingly political, economic and scientific activities are conducted at the international level, nations seem to have lost grips of things taking place within their borders in a number of domains (Braman, 1995).

With the rapid development of communications technologies, media are also becoming regional and global, contributing to both the rise of globalism and, presumably, the decline of sovereignty.

The first major threat to government control over mass media was direct broadcast satellite (DBS). When the issue of direct television broadcast via DBS was discussed in the United Nations in the 1970s and 1980s, whether free flow of information or national sovereignty should take priority was the center of heated debates (Fisher, 1990).

Concerns of developing nations over the influences of uncurbed transnational flow of information and television programs were illustrated in the Argentine draft of DBS convention. In contrast to the U.S. draft which advocated for the encouragement and expansion of free and open exchange, the Argentine draft sought to subject DBS broadcast to "national sovereignty, the fundamental rights of states, the family and the individual" (Fisher, 1990: 121; draft article 2).

It is perhaps least surprising that resolutions that were adopted after heated debates as those over DBSreflected only the compromises that national delegates reached, while decision makers were left to feel their way through the miring forces of communication technologies.

Today transborder television broadcast is part of everyday life for billions of people around the world. Regulations of satellite television have been significantly relaxed in many Asian nations (Chan, 1994; Wang, 1997), however national governments have not ceased trying to exercise some form of control. A survey of 12 Asian nations and territories showed that only four--Hong Kong, Japan, Thailand and the Philippines--did not have any restrictions on transborder television broadcast (Wang, 1997). Among nations which kept satellite television regulated, China and Singapore were among the ones with most vigorous restrictions.

After initial attempts by the government to block the signals, satellite television is now available to average families in both Singapore and China. However it would be grossly underestimating the power of the state if the popularity of satellite television were used as an indicator of its strength.

In both China and Singapore nowadays, satellite television is put under control through cable networks while direct reception through dishes is banned. In addition, the Singapore government has succeded in acquiring cooperation from a number of transnational channel operators in submitting their programs prior to broadcast, so that necessary changes could be incorporated after screening. According to a HBO executive, the arrangement is "mutually beneficial" because "whatever is acceptable to Singaporeans should be acceptable to other nations" (Clark and Huang, 1997).

Satellite television may be the first major challenge to national sovereignty by communications media, but was certainly not the onlyone on the list. Concerns over sovereignty rights very similar to what was voiced in the DBS debates were heard in international meetings on transborder data flow (TDF). Delegates from developing nations insisted that information be treated as a public good, for the UN Resolution of Permanent Sovereignty over Natural Resources stated that sovereignty over natural resources was a "permanent and fundamental right of nations" (Adams, 1983: 41). Unfortunately whether information was a natural resource or a public good was not established in international laws, although it was recognized that international laws legitimated the regulation of cross-border flows (Drake, 1993: 279).

The debate on TDF issues, therefore, failed to arrive at any solution to the problem, just as the debate on DBS did. But what canbe learned from the DBS example is that the autonomy of nation states may have been circumscribed by transnational media, however this is not the end of national sovereignty.

In 1979, Waltz (1979) wrote: "the sovereignty of states has never entailed their insulation from the effects of other states actions." National sovereignty, therefore, is not necessarily undermined or eroded simply because activities within a nation are affected by what happened outside of its territory. As Hamelink (1993) observed, even with far-reaching economic integration of the European Community member states, sovereign states is still the basic unit of European politics.

Following this line of thinking, national sovereignty is far from being dead. As some critical theories suggested, it is through the "practices of power relations and norm development" that sovereignty is structured and contested (Rosenberg, 1990; Drake, 1993). Regulating a global medium such as Internet may very well be just one of the "practices" that sovereignty is being contested.

Conclusion

When the first laws in regulating network communication came into effect in 1996, Singapore had an estimate of 150,000 Internet users, while China had about 100,000. The number, however will not likely remain at that level as both governments have undertakenvigorous plans in building the information infrastructure.

In 1994, the number of computer servers in Singapore was only 0.1 percent of the world total, and China, 0.01 percent. However the growth in computer networks was also phenomenal; Singapore's figure represented a 45 percent growth from the previous year (Yang, 1997), and China's computer industry wasgrowing at an average of 28 percent a year (Huang, 1997). It was estimated that by the end of the century, annual sales of computers would reach ten million in China, making it the world's second-largest computer market--next only to the U.S.

Analysts have pointed out that putting network communication under control in China might be possible in the mid-1990s for two major reasons: a) most of the online services had very little to offer besides email communication, and b) many potential users lack the English language skill to master the system. The situation, however, will change. As network communication grows in popularity and sophistication, the task of regulating the medium will also become more challenging.

Challenging as the task may be, the determination of Asian leaders in carrying it out does not seem to be affected. On the contrary, the more popular and sophisticated network communication is, the more urgent the task becomes. In early September 1996, a meeting of the member states of the Association of South-East Asian Nations (ASEAN) was held in Singapore to discuss the promotion and policing of the Internet. No agreement was reached regarding a common approach to regulation, but the meeting showed that Singapore and China would not be the only Asian nations that try to regulate transnational information flow over the networks (The Economist, September 14, 1996).

In the end, whether network communication can be effectively regulated may not even be the most critical question. A Singapore minister openly admitted that all the government was doing was to stop pornography from being one click away, considering the ingenuity of surfers and the inexhaustible number of sites (South China Morning Post, September 20, 1996).

To many Asian leaders, what is really important perhaps, is to make known where the government stands on the issue. When asked about the effectiveness of the measures in controlling information over the networks, a Singapore officer stressed that the government was under no illusion that it could police every site, picture and videoclip; the intention was to "set a standard which reflected its values even though that standard would not always be attained. (South China Morning Post, September 20, 1996)"

Regulating transnational information flow over the networks, therefore, is not just a demonstration of what can be done, but what should be done when national sovereignty is considered.

References

Adams, J. M. (October 1983) Canada's Future TDF Policy: Reconciling Free Flow with National Sovereignty. Transnational Data and Communications Report, 6, pp. 405-411.

Branscomb, Anne Wells. (1993) "Jurisdictional Quandaries for Global Netorks." In Linda M. Harasim (Ed.) Global Networks: Computers and International Communication. Cambridge, MA: The MIT Press, pp. 83-104.

Drake, William J. "Territoriality and Intangibility: Transborder Data Flows and National Sovereignty." In Kaarle Nordenstreng and Herbert L. Schilller (Eds.) Beyond National Sovereignty: International Communication in the 1990s. Norwood, New Jersey: Ablex, pp. 260-343.

Braman, Sandra (1995) "Horizons of the State: Information Policy and Power." Journal of Communication, 45(4), pp. 4-24.

Chan, Joseph Man. (1994) "National Responses and Accessibility to Star TV in Asia." Journal of Communication, 44 (3), pp. 70- 88.

Clark, Judith and Yu Huang (February 1997) "A Study of the Development of Satellite Broadcasting and Government Control: The Case of East and Southeast Asia." Radio and Television: 3 (1), pp. 137-141.

Fisher, David. (1990) Prior Consent to International Direct Satellite Broadcasting. Dordrecht: Martinus Nijhoff Publishers.

Hamelink, Cees J. "Globalism and National Sovereignty." in Kaarle Nordenstreng and Herbert L. Schiller (Eds.) Beyond National Sovereignty: International Communication in the 1990s. Norwood, New Jersey: Ablex, pp. 371-393.

Huang, Yu. (May 20-22, 1997) The Plight of Chinese Government Information Control--A Discussion of the Effect of New Media Technologies. Paper presented at the Fifth International Conference on Television, Film and Video Images, Taipei, Taiwan (in Chinese).

Lange, L. (October 2, 1995) "Develping Nations." Information Weel.

Liu, C.Y. (1996) "Law and Technology in the Information Age."
Yue-dan Law Review, 19, pp. 145-148 (in Chinese).

Millard, Christopher. (February 1997) "Local

Content Filters and the 'Inherent Risk' of the Internet." Intermedia, 23 (1), pp. 21-22.

Rosenberg, J. (Summer, 1990) "A Non-realist Theory of Sovereignty? Giddens' the Nation-state and Violence." Millenium: Journal of International Studies, 19, pp. 249-259.

Waltz, K. (1979) Theory of International Politics. Reading, M.A.: Addison Wesley.

Wang, Georgette (July 3-7, 1997) "Protecting the Local Cultural Industry: A Regulatory Myth in the Global Age." Paper presented at the International Association for Media and Communication Research, Oaxaca, Mexico.

Yang, Chung-chuan (1997) "The Impact of Internet and Global Information Highly on Telecommunications Policy." Journalism Research, 55, pp. 16-39 (in Chinese).

The Shaping of the Universal Service Obligation in Telecommunications for a Competitive Environment: a Review of Policy Change in the United States, Australia and New Zealand

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1. ABSTRACT

The Universal Service Obligation (USO) is a central element in the social contract between the provider of telecommunications and the state. This paper describes the major aspects of these changes in three economies: the United States; Australia; and New Zealand. For each of the three countries, the different legislative and funding approaches being adopted are discussed. It is argued that, in some respects, the new relationships being forged under competition could undermine the social benefits that are traditionally thought to be derived from the USO.

2. INTRODUCTION

According to Eli Noam, beyond the initial start-up costs, a telephone network "will grow on its own":

> Through this phase of network growth, which can be called the "cost-sharing" phase, the network users can lower their cost by adding members. However, at some point average costs increase, and utility plateaus..... Left to themselves, the existing subscribers of the network would not accept members beyond that private optimum (Noam, 1994, p. 689).

Beyond the generally beneficial cost-sharing stage, governments usually impose universal service obligations (USO) upon dominant carriers in order to ensure service to those still not on national networks. Even with government-engendered subsidies, telephone penetration rarely exceeds 95 per cent. The cost of serving people in remote areas is one major barrier to universal telephone penetration and the cost of service anywhere may preclude or severely limit usage by the poorest segment of society . Neither of these groups, remote or poor, can pay the full cost of their telephone service and service to them must be subsidized if the society agrees that the social benefit of telephone service to these groups is sufficiently high. Thus, universal telephone service is a political as well as an economic issue.

Political problems associated with universal service do not disappear, however, once a society decides that everyone benefits from ubiquitous usage. First, the level of service still has to be defined, not an easy task in an age of rapidly changing technology. The old notion of USO required dominant carriers simply to supply dial tone to subscribers. Now many regulators and industry leaders agree that plain old telephone service (POTS) also must include touch-tone, single-party and emergency services. And a growing number of people are insisting that POTS must be expanded to include PANS (pretty advanced new stuff) such as wider-band connections (e.g., ISDN), Internet access, and, eventually, video conferencing capability.

Second, related to whether or not PANS should replace POTS as the USO requirement, are questions of universal access vs. universal service. The latter term implies that everyone will get the same things regardless of ability to pay or location. But basic service is not the same as universal service and neither are the same as access to services. Access to services is the real briar patch of USO issues. What exactly does access mean? That you can get whatever you want if you can pay for it ? Or that involved services are available atreasonable prices and that you have the equipment and skills to use them beneficially?

Third, once the decision has been made to impose USO and the expected level of service has been defined, another political issue is how to pay for the program. The major questions here are who should pay and through what mechanisms. A number of subsidization mechanisms exist such as internal cross-subsidization. In addition to cross-user type subsidies, external subsidies may help companies serve high cost areas or help poor people pay their telephone bills. Such mechanisms are fairly straight forward but require supervisory regulation to implement and maintain even under a monopoly situation.

In summary even though countries move toward telecommunications competition mainly for economic reasons (to make a nation more competitive, to better serve the interests of the business community, to encourage technological innovation, and so forth), this path leads to three USO political issues: how to determine the social benefits of different levels of universal service, how to allocate services in a technologically dynamic environment, and how to pay for whatever services fall under the newly defined USO. This paper examines how three countries--New Zealand, Australia and the United States--are trying to answer those questions. The three sample countries represent divergent deregulatory roads but they all lead in the same direction to a competitive, more technologically advanced telecommunication environment. These three countries were chosen because of their cultural similarities in the Pacific region, their relatively high percentages of rural regions (frequently the recipients of USO funds), and their early regulatory reforms that introduced telecommunications competition (Nevitte and Gibbons, 1990, p. 1).. As well, in terms of the changes in telecommunications technology, both Australia and New Zealand have been strongly influenced by the United States.

For each of the countries below we provide a brief description of the separate routes to deregulation and competition in telecommunications and then assess the implication of this for future USO policies. We believe these comparisons may prove useful to countries who are now contemplating deregulation.

3. DEVELOPMENT OF COMPETITION AND USO POLICIES IN TELECOMMUNICATIONS IN THE SAMPLE COUNTRIES

3.1 NEW ZEALAND

New Zealand's recent history of telecommunications reform can be taken from early 1987 when the nation's Fourth Labour Government was returned to power for a second term. In early 1987, the public debt was $NZ42 billion or 81 percent of gross domestic product (Hyde, 1991, pp. 55-69), a state of affairs that was of deep concern to The Treasury as well as politicians. Increasingly, after the Fourth Labour Government returned to office, The Treasury saw asset sales as part of a necessary economic strategy (Mascarenhas, 1991). So committed did The Treasury become to the principle of "less intervention and more competition in the economy" that even deep divisions in the Labour Cabinet over the need for privatization did not sway Treasury from its drive towards privatization of state assets (The Treasury, 1987).

Pressing on with their view of economic rationalization, The Department of Trade and Industries and The Treasury engaged a firm of international consultants (Touche Ross), in mid 1987, to ensure that competition was introduced into telecommunications. At the same time pressure built among the Government's advisors and commercial interests for asset sales to be used to off-set the ever increasing public debt. In retrospect, the privatization move was fostered largely by the Government's economic advisors and the New Zealand Business Round table (an influential lobby group for large corporate interests) some of whose members already were playing key roles in running the Government's State-Owned Enterprises (SOEs) (Hyde, 1991).

Early in 1988 the Government made it clear that it viewed asset sales as a means of reducing the public debt (Mascarenhas, 1991). In the July budget of that year the criteria for asset sales were listed and at the same time it was emphasized that corporatization was not working; which is really rather problematic as none of the SOEs had been corporatized for more than about a year when this was first announced (Mascarenhas, 1991). Later that year the Ministry of Commerce was set up to offer advice to the Minister of Communications, and as one of its duties it took over the responsibility for administering the Government's telecommunications and broadcasting regulations. The Commerce Act became the defining act for fair competition in the market place and with entry of deregulation in broadcasting Television New Zealand and Radio New Zealand were created as separate SOEs. (Rodger, 1988). It was not long before the broadcasting spectrum became a marketable commodity and state television (TV1 and TV2) started competing with TV3 a private company for advertising dollars.

The Government adopted a so called "light handed regulatory approach" which appeared to the free market purists to be the ideal policy in the period leading up to the privatization of Telecom New Zealand in 1990. This policy in retrospect has proved to give stronger negotiating powers to the dominant carrier over its competitors. A major competitor to Telecom New Zealand, Clear Communications commenced operations in 1990.

Early in 1990, the Government announced that the worsening economic situation necessitated the sale of Telecom (the jewel in the crown of state assets). Although there was considerable opposition to the sale both within and outside Parliament (Issac, 1990), the Government went ahead and sold Telecom for $NZ4.25 billion to a consortium of Bell Atlantic, Ameritech, Freightways and Fay Richwhite (the latter two were New Zealand companies with 5 percent each of the shares). Bell Atlantic and Ameritech were required by the sale agreement to reduce their combined holdings in the company to 49.9 percent over the next three years. Another condition of the sale was that the New Zealand Government would retain a controlling interest in the privatized Telecom Corporation of New Zealand by virtue of what is known as "the Kiwi Share" (Prebble, 1990). The 'Kiwi Share' essentially maintains the remnants of the USO obligation in New Zealand.

Even though a New Zealand Ministry of Communication official recently pointed out (Galt, 1996) that "universal service has not been a commonly used term in New Zealand telecommunications policy" (p. 1), long before the State codified USO requirements, there was an unwritten expectation that all New Zealanders would be able to access a telephone line and that this line ought not only to be affordable to even the poorest citizens, but it ought also to allow free local calling for all users (Wagner, 1984).

In effect, there is nothing very permanent about the Kiwi Share but, at this point in time, it served to define a kind of universal service for residential users.

In Telecom's Articles of Association, the Kiwi Share (only one convertible preference share) imposes four obligations on Telecom:

- Telecom's standard residential line rental rates can increase only in accordance with consumer price index increases;

- Telecom can charge rural residential users no more than the standard residential line rental;

- Telecom must maintain a local free-calling option (in New Zealand local residential calls are unmeasured); and

- Telecom must maintain the extent of the network as it was in November 1990 (Williamson, 1996, p. 2).

There are three matters concerning universal service that the New Zealand Government will be looking at in the future. First, in a free modern economy competitive markets ought to provide the kinds of telecommunications services that people want without Government intervention. And yet the New Zealand experience to date indicates that even though "The Government does not know best", about what suits the needs of the telecommunications industry (Williamson, 1996, p. 6), it will still be required to intercede in the industry's business practices from time to time as arbiter on some occasions (as in the interconnect issue mentioned above) and as protector of the common interests (ensuring that every New Zealander irrespective of socio-economic status has access to a telephone) on other occasions.

Second, there is a growing concern in advanced Western societies that some of the "have nots" are falling through the net and do not have access to a telephone line at an affordable cost (U.S. Department of Commerce, 1995). This matter has recently been debated in the Wellington newspapers with Telecom denying the claim that up to 40% of people in parts of Porirua (a low income suburb of Wellington) are without a telephone (Perry, 1996, p. 4).

Third, it would appear to be in the interests of all common carriers to offer enhanced services to their clients. In some respects they are proactive (for example, fibre optic cables and ISDN) and in other respects they can be slow and reactive (e.g., Telecom's Xtra, a late entry into the Internet Service Provider market). Gabel (1996) claims that Telecom has no incentive to provide a better service to its residential customers because there is no competition in the market. Furthermore, he argues, while residential services have been subsidized in the past this is not the case any more. Gabel concludes his paper by saying:

> "While the current light-handed regulatory regime has provided important benefits to New Zealand, the governance structure of that regime does not provide a mechanism which will enable the consumers to benefit from cost reductions being realized by local service network operators around the world." (p. 7).

In other words the Kiwi Share is being used as an obstacle by the dominant carrier for passing on price reductions to its customers. The Government now recognises that when it introduced the written version of the Kiwi Share it did so as an expediency. Now, in a changing and dynamic telecommunications environment, it has to deal with the consequences of what the Kiwi Share really means to the industry and the all New Zealand telephone subscribers. The Kiwi Share, which is in reality a limited version of the Government's universal service obligations, and a carry over from pre-privatisation times, is clearly in need of revision. It is acknowledged in the industry that a revision should be undertaken, not with a view of getting rid of the obligations, for there is evidence that universal service obligations are consistent with the promotion of competition in the telecommunications industry (Lipman, 1996), but in order to pass on new technology savings to the customers. In the light of Telecom's escalating annual profits there is little evidence that residential customers are benefiting in spite of high profile marketing ploys such as weekend $5 toll calls and reduction in long distance tolls which are, after all, big money spinners for Telecom.

3.2 AUSTRALIA

Recent structural change in Australian telecommunications commenced with a major economic statement in May 1988 by the then Labor Government (Evans, 1988). Telecommunications formed a central part of this. Part of the telecommunications market was to be liberalised and opened up to competition (e.g. value-added services, customer premises equipment). A regulator, the Australian Telecommunications Authority (Austel) was established to regulate competition and consumer issues, among others. Telecom Australia's monopoly over facilities and basic services was to remain intact but the need to invest in network modernisation was increasing pressure on the Government to provide it with the necessary capital.

While the Labor Government had moved a considerable way towards deregulation, it was the ever growing debt of Aussat (the national satellite system) that pushed it to consider major structural and ownership reforms of the industry. By 1988-89, Aussat's accumulated debt had reached A$478 million (Leonard, 1990).

As a result, it was announced in 1990 that Aussat was to be privatised and Telecom Australia and OTC (the government authority responsible for international telephone traffic) merged to form the core of another carrier (to be called the Australian and Overseas Telecommunications Corporation--AOTC). It was announced that AOTC would then compete in a duopolistic arrangement until 1997 with a new carrier, the core of which would be the privatised Aussat. Since 1993, the name of the interim organisation, AOTC, has been progressively replaced with the new corporate name Telstra. The crucial decisions on industry structure were taken at the end of 1990 together with a decision to allow three competing carriers into the mobile market. The successful bidder for the Aussat satellite was Optus Communications, a consortium involving Bell South, Cable and Wireless, Mayne Nickless, AMP and National Mutual. Arena GSM (later to be called Vodafone) was successful in obtaining the third mobile licence at the end of 1992.

The issue of universal service has been one particular theme that has been prominent in debate since the introduction of competition. The provision of a universal telephone service has been a long-term policy objective of successive Australian governments. Under the monopoly arrangements, Telecom Australia was expected to fund universal service from its profitable services. Telecom Australia met the demands of the legislation which imposed universal service obligations on it. In 1975, for example, some 62 per cent of households in Australia had telephones connected and this had risen to almost 95 per cent by 1990 (Wilson and Goggin, 1993, p.7). With the introduction of competition, government legislation provided two obligations on universal service: first, it must be provided; and, second, "where delivery of universal service results in a net cost to the universal service carrier [Telstra], the cost of fulfilling the delivery can be shared among all the carriers on an equitable basis" (Department of Communications, 1994, p. 54). In effect, "the cost of universal service is shared by the carriers (Telstra, Optus and Vodafone) indirect proportion to each carrier's share of timed connections (in minutes) established across telecommunications networks in Australia" (Bureau of Transport and Communications Economics, 1995, p.39). One of the key issues has been the definition of "universal service" adopted by the government. "Universal service" under the legislation in force since 1991 refers to "the standard telephone service, payphones and other prescribed services being reasonably accessible to all people in Australia on an equitable basis, wherever they reside or carry on business" [Department of Communications, 1994, p. 54] . Consumer groups have taken a somewhat broader view of the definition (Wilson and Goggin, 1993). The definition became subject to scrutiny as part of a major inquiry in the provision of broadband network services in Australia (Broadband Services Expert Group, 1995) and the Review of the Standard Telephone Service (Standard Telephone Service Review Group, 1996).

Following the change of government in Australia in March 1996, further legislative reform led to a new *Telecommunications Act 1997.* From 1 July 1997, the Australian telecommunications market was opened to full competition. The new Australian legislation effectively extends the provisions of the 1991 Act but makes changes that: ensures the scheme will work in an open licensing environment; clarifies and extends the USO; enhances efficiency in delivery; and improves the accountability of universal service providers. One of the most significant changes is that the Minister for Communications is able to determine a system for the selection of national and regional universal service providers, including tendering out all or part of the USO in particular areas. The 1991 Act levied carriers in accord with a carrier's share of timed traffic as the basis for calculating the share of the total net universal service cost payable. Under the new legislation, *Telecommunications Act 1997*, contributions are proportional to each participating carrier's share of total 'eligible revenue'. In effect, the new regulator, the Australian Communications Authority (ACA), will be able to designate certain areas as net cost areas and carriers will be able to claim costs for providing a USO in these areas. At the moment, Telstra is still the Government's designated universal service provider. In addition to the ACA, the Government has shifted the responsibilities for the regulation of competition in telecommunications to a new regulatory body - the Australian Competition and Consumer Commission (ACCC).

3.3 USA

For the purposes of this paper the early 1980s represent an important starting point for analysis. By this time the notion that telephony is a "natural monopoly" had succumbed to the reality of competition in customer premises equipment and long distance. In addition the convergence of computers and telecommunication plus the increasing internationalization of markets and operations rendered not only voice telephony but also data exchange crucially important to businesses. Their leaders threatened to build private networks if clearer, wider-band and cheaper public lines were not made available, a development that would have endangered the traditional cross-subsidy of residential service by business subscribers. In 1976 when the Department of Justice launched yet another anti-trust suit against AT&T, the company was embroiled in an internal dispute about whether to ignore mounting pressure to change its organizational structure and goals or to embrace new technologies and recognize the competitive wolf, who was not just at the door but had clearly crossed the threshold. A change of administration from traditional to new-horizon executives took place on the heels of a failed AT&T attempt to force national legislation that would have protected its monopoly against further encroachment and just before MCI won a huge monopolistic practices suit against Ma Bell. Although in 1981 AT&T made $16 million each day, had assets of $150 billion (a figure exceeded by the gross national product of only 20 countries), and could clearly afford to settle with MCI, the competitive writing was on the wall. AT&T's more forward-looking new leaders chose to negotiate a modification of the final judgment of an old Department of Justice suit launched in 1956. The Modified Final Judgment resulted in AT&T's 1984 divestiture of its local telephone companies. The Bell Operating Companies (BOCs) were spun-off into seven Regional Holding Companies (RHCs). AT&T retained Western Electric (later renamed), Bell Labs (whose function became more applied and less theoretical) and the Long-lines Division. Western Electric eventually became the independent Lucent Technologies. AT&T also spun-off a newly acquired computer division and acquired McCaw Wireless. Thus, the main telecommunication activities of today's company are long distance and wireless telephony. Ironically, the phrase "universal service" was coined by the first CEO of AT&T, Theodore Vail, to convince regulators of early telephony that a single monopoly telephone system would be economically more efficient than dual, unconnected competitors. The seeds of a socio-political universal service policy appear to lie in the opening paragraph of the Communications Act of 1934 in which Congress set up the Federal Communications Commission for the purpose of

> . . . regulating interstate and foreign commerce in communication by wire and radio so as to make available, so far as possible, to all the people of the United States a rapid, efficient, Nation-wide, and world-wide wire and radio communication service with adequate facilities at reasonable charges . . . . (Title I, Sec. 1, par.1).

A system of internal cross-subsidies evolved within AT&T to keep rates "reasonable" for all customers, no matter where they were located. Before the break-up, urban, business and long-distance customers paid higher-than-necessary charges so that rural, residential and local subscribers could pay lower-than-cost charges. Independent (not part of the Bell system) rural telephone companies were further helped by the Rural Electrification Administration (REA, newly renamed the Rural Utilities Service,RUS) low-cost loans which enabled expansion and upgrading of rural facilities. Traditionalists within AT&T argued that internal cross-subsidies would disappear with the introduction of competition. To prevent subsequent damage to universal service as a result of the MFJ, a complex array of funding mechanisms was set in place. Currently, long distance (interexchange carriers or IXCs) companies pay fees according to how many subscriber lines they have in each exchange. "Access" charges also are calculated based on local companies' costs to accommodate IXC traffic (access charges account for more than one-third of local companies' revenue.) Individual subscribers also pay a monthly charge called the "Subscriber Line Charge." Recently, mainly as a result of intense AT&T lobbying, the FCC increased the SLC in order to reduce access charges. Rural telephone companies with subscriber loop costs in excess of national average subscriber loop costs are eligible for universal service funding to reduce their costs to the 115 percent level. Bell Operating and GTE (which has had its own consent decree) companies are ineligible for universal service funding and have been expected to continue traditional cross-subsidies to keep all rates "reasonable." Individual poor people can get their monthly bills and installation charges reduced through "Life-Line" and "Link-Up" programs, which are partly paid for by state and federal funds. Despite a 94 percent telephone penetration rate, some areas of the US still do not have telephone service or are underserved. Without the current USO subsidies, many other rural customers might well go unserved as service is directly related to cost-per-loop which increases inversely to population density. February 1996, after 20 years of struggle over bills to revamp the Communications Act of 1934, Congress passed a new telecommunications act. The Telecommunications Act of 1996 acknowledges the new communications environment, addresses many of the problems engendered by the break-up of AT&T, and further opens electronic communication markets. It expands the number of TV stations one entity can own, largely eliminates radio ownership rules, permits competition between cable television and telephone companies, allows Bell Operating Companies to enter the long distance and manufacturing markets (once they sufficiently open their local exchanges to competition), and opens up that last bastion of monopoly service, the local telephone market. Universal service sections stipulate the following principles:

- States can designate the common carriers who qualify for universal service support and will designate carriers who are best equipped to serve areas presently unserved and order them to do so. Designated carriers can relinquish USO only with State approval and only if another eligible carrier assumes USO for the service area in question. (Section 102)

- A federal-state joint board on universal service is established "to recommend changes to any of the [FCC's] regulations in order to implement [universal service sections], including the definition of the services that are supported by Federal universal service support mechanisms . . . ." (Section 254)

- The Joint Board and the FCC are to base their USO policies on the following principles: quality and rates; access to advanced services; access in rural and high cost areas (services and rates "reasonably comparable" to those available in urban areas); equitable and nondiscriminatory contributions (by all telecom providers); specific and predictable support mechanisms; and access to advanced telecommunications services for schools, health care, and libraries. (Section 254)

- A new definition of universal service will encompass "an evolving level of telecommunications services that the Commission shall establish periodically . . . taking into account advances in telecommunications and information technologies and services." (Section 254)

- All carriers that provide "interstate telecommunications services shall contribute, on an equitable and nondiscriminatory basis, to the specific, predictable, and sufficient mechanisms established by the Commission to preserve and advance universal service." (Section 254)

Each of these stipulations remains highly controversial and the debate surrounding them can be observed on the following Internet sites: FCC Universal Service Pages (http://www.fcc.gov/ccb/universal_service/welcome.html); Benton Foundation (http://www.benton.org/Policy/96act/jboard.html); United States Telephone Association (http://www.usta.org/univplan.html); National Exchange Carriers Association (http://www.neca.org).

4. COMPARISON AND COMPETITIVE FACTORS AND USO POLICIES IN THE SAMPLE COUNTRIES

The US deregulatory process differed in details from those of NZ and Australia primarily because American telecommunications was always in private hands. NZ and Australia in the beginning used--and, to a great extent, still use today-- a public interest model of regulation whereby the needs of society are considered, a government entity is created to address those needs, a system is put in place, and the system adopts technologies as they became available and are deemed appropriate. NZ and Australian telecommunications began as government enterprises and, even after deregulation and the introduction of competition, government decisions remain the major determinants of system structures and functions.

There are reasons to explain why deregulation occurred in telecommunications in our three sample countries. Some of the reasons are the same, especially those that relate to worldwide economic and technological processes occurring everywhere. Some reasons are different according to unique circumstances within each country. The economic and social consequences of policy changes are, for the most part, identical and perhaps inexorable. The question now is what does this mean for USO and the communication needs of those people in danger of being left out of the new era.

The competitive era has begun in all three countries examined in this paper but the full impact of what it means will not be felt for several decades. While competition is now present among telecom providers in respect to Customer Premises Equipment (CPE), long distance and, soon, local services, merging of various types of communication systems and the new competitive situation that this phenomenon heralds is only on the horizon. For example, satellite competition within Australia is still a strong possibility now that Optus owns Aussat and can explore Low Earth Orbiting Satellite (LEO) possibilities. Thus Australian government so constrained Aussat's functions that the satellite system went deeply in debt. But the Aussat's potential for competing with Telecom, was not the only reason that the satellite system became so unwieldy. Whether Aussat could have competed in provision of telephone services even without its deadly regulation, is questionable. Geosynchronous satellites are not well suited to voice service and, because the interior is quite flat, terrestrial radio-based telephony works quite well in the outback. Now technology has changed and LEOs offer realistic competition for all types of communication services everywhere.

The same situation applies in NZ and the US. Even though the US pioneered in satellite communication, satellites began as common carriers and were used as aids to AT&T's long distance transmission rather than as competitors. In NZ the government forbade installation of satellite-based systems (using Aussat) because of potential competition with TVNZ. Now TVNZ already has private competition and the argument against satellites makes little sense. In the US, it is cable television, which is only beginning to be installed in the other two countries, that offers strong competitive possibilities for all types of communication services at this point. However, its traditional television service is being challenged by direct-to-home satellite service and various terrestrially-based wireless television services, including soon to be digitized broadcast TV

5. CONCLUSION

Blackman (1995) defines "access to telecommunications services as a basic right of all citizens (the right to communicate) which is essential for full participation in the community and as a basic element of the right to freedom of expression." He adds legal and economic details to this social definition by requiring 1) geographically-neutral standard telephone service, 2) non-discriminatory access, and 3) reasonable costs or affordability (emphasis ours). Each of the emphasised terms is now highly controversial. The definition of universal service, although not necessarily specified, was fairly clear in the past, at least in our three sample countries. Now competitors closely represent their economic self-interests in the positions they take on these basically political questions. As more and different competitors enter the field, the complexities of the situation will increase and the political issues are likely to become even more intractable in regard to USO.

The review of the three sample countries shows that the evolution of competition in telecommunications is closely linked to changes in the USO policies of the respective countries. It is evident that in the new competitive environment there is scope for thinking more broadly about the USO concept than is traditionally accepted. If the USO concept continues to be too closely tied to the politics and structure of evolving competitive markets, there could be a real possibility that national benefits from telecommunications could be foregone. The concept of USO must retain its essential element of a social contract but be flexible enough not just to include telephony but now information - transcending the catch cry of competition and making it more relevant to the changing nature of the economies of the sample countries.

6. REFERENCES

Blackman, C R (1995), 'Universal service: obligation or opportunity?', *Telecommunications Policy*, Vol. 19, No. 3, pp. 171-176

Broadband Services Expert Group (1995), *Networking Australia's Future*, Final Report of the Broadband Services Expert Group, Australian Government Publishing Service, Canberra.

Bureau of Transport and Communications Economics, (1995) *Telecommunications in Australia*, Report 87, AGPS, Canberra,, p.39

Consumers' Telecommunications Network (1995), *For Whom the Phone Rings: Residential Consumers and Telecommunications Competition*, CTN, Surry Hills, NSW.

Department of Communications and the Arts (1994), *Beyond the Duopoly: Australian Telecommunications Policy and Regulation*, Department of Communications and the Arts, Canberra, p. iii

Evans, G. (1988), *Australian Telecommunications Services: a new framework*, Australian Government Publishing Service, Canberra,p. iii

Gabel, D. (1996). 'Is residential telephone service subsidised?: Moving past the rhetoric through an empirical analysis of the cost and revenue associated with the Kiwi Share', An address at a Telecommunications Universal Service Symposium, Wellington, 1-3 July. Wellington: TUANZ in association with The Centre for Research in Network Economics and Communications, University of Auckland.

Galt, D. (1996). 'A New Zealand perspective on universal service in telecommunications'. An address at a Telecommunications Universal Service Symposium, Wellington, 1-3 July. Wellington: TUANZ in association with The Centre for Research in Network Economics and Communications, University of Auckland.

Hyde, T (1991), 'How they sold Telecom, why they sold Telecom', *Metro*, September, pp. 55-69

Issac, P. (1990), 'Backbenchers a threat to Telecom float', *The Dominion*, 15 January, p. 20

Leonard, Peter (1990), 'Footprints Down a Narrow Road', *Media Information Australia*, No. 58, November, pp. 36-41

Lipman, A. (1996). 'Demystifying universal service and developing rational policies'. An address at a Telecommunications Universal Service Symposium, Wellington, 1-3 July. Wellington: TUANZ in association with The Centre for Research in Network Economics and Communications, University of Auckland.

Mascarenhas, R.C. (1991), 'State-owned enterprises', in J Boston, J Martin, J Pallot and P Walsh (eds), *Reshaping the State*, Oxford, Auckland

Nevitte, N. and Gibbons, R. (1990), *New Elites in Old States: Ideologies in the Anglo-American Democracies*, Oxford University Press, Oxford, UK

Noam, Eli (1994), 'Beyond liberalization III: Reforming universal service',

Telecommunications Policy, Vol. 18, No. 9, pp. 687-704

Perry, A. (1996). Kelly, Telecom differ on phone access. Comment, The Dominion, July 15, p. 4.

Prebble, R (1990), Final step in Telecom sale, Media Release, Minister for State-Owned Enterprises, 12 September

Standard Telephone Service Review Group (1996), *Review of the Standard Telephone Service*, Department of the Communications and the Arts, Canberra, December

The Treasury (1987), *Government Management: Brief to the incoming government*, Government Printer, Wellington

U.S. Department of Commerce. (1995). *Falling through the net: A survey of the "have nots" in rural and urban America*. Washington: NTIA.

Wagner, G (1984), Telecommunications policy-making in New Zealand during the last two decades, *Telecommunications Policy*, Vol. 8, No. 2, pp. 107-126

Williamson, M. (1996). "USOs: The New Zealand Government's view'. Address by the Hon Minister of Communications at a Telecommunications Universal Service Symposium, Wellington, 1-3 July. Wellington: TUANZ in association with The Centre for Research in Network Economics and Communications, University of Auckland.

Wilson I. and Goggin G. (1993), *Reforming Universal Service: The future of Consumer Access and Equity in Australian Telecommunications*, Consumers' Telecommunications Network, Redfern, NSW, Australia, pp. 5-6

Access & Interconnection

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1. ABSTRACT

The terms *access* and *interconnection* are often used interchangeably and with little precision. However there are two fundamentally different reasons for connecting telecommunications networks together. These reasons need to be understood in order to develop a sensible regulatory environment. This paper proposes distinct definitions for access and interconnection and explains the differences between them and their significance in terms of regulatory intervention.

2. ACCESS & INTERCONNECTION

2.1 THE THEORY

The concepts of access and interconnection are central to any understanding of the telecommunications services provided by multiple suppliers, yet there appear to be no generally accepted definitions for the terms. They are often used without any attempt to distinguish between them or to understand the different purposes that they serve. Further confusion arises from the more general use of the term *local access* in a different context to refer to the connection between a customer and the network.

In this paper, the terms *access* and *interconnection* are used for quite specific purposes. Access is used in the context of access to infrastructure for economic or competitive purposes. This includes access to the services provided by that infrastructure. *Interconnection* is used in the context of interconnection of networks to achieve connectivity between those networks; it is concerned with enabling any user on one network to connect to any user on any other network and has minimal competitive significance. The use of these two terms in this paper is quite arbitrary. It is simply a convenient means of describing the different characteristics of the services provided by carriers and service providers to each other in a competitive telecommunications market. The importance of the distinction between the two concepts will become apparent later in this paper.

A common theme of the discussion surrounding the reform of the telecommunications industry has been the uniqueness of the industry compared with other network industries such as electricity, gas, and water distribution. Telecommunications networks share many characteristics with other types of network. However, the major points of difference are that a telecommunications network generally provides point-to-point rather than point-to-multi-point (distribution) connections(1) and it can provide different services over the same network. Even where telecommunications services are provided on a point-to-multi-point basis, it is usually a limited, rather than ubiquitous, form of distribution.

The products provided over a telecommunications network are not fungibles. A call from C to D, or even a call from A to C, is not a substitute for a call from A to B. Similarly, a data call between two points is not a substitute for a voice call between those same two points. Most other utilities provide a unidirectional distribution (or collection) service for products which have largely indistinguishable origins and characteristics. The user of water or electricity will be largely unaware of and indifferent to the origin of the product that they are consuming and would not expect to receive more than one product from the distribution network. Similarly, the producer of the product will often not be aware of the individual users of the product and will see only the aggregate demand.

In these respects, telecommunications networks have greater similarity with transport networks than with the distribution networks with which they are frequently compared.Because both the origin and the destination of a connection are important for a telecommunications service, these origins and destinations are individually identified; in the most simple case, with telephone numbers. There is no equivalent in the other network industries. The provision of a unique address or telephone number to each location on the network means that there is only one way in which a call can be connected to that location and that is through the network which has been allocated that number.

Interconnection is necessary to increase the population of accessible destinations and thereby to improve the utility of the service to consumers. It is necessary wherever there is more than one network providing the same, or a similar, service. It is not associated with competition in a market between the owners of those networks.

For example, the telecommunications networks in two adjacent sovereign states, each owned by a separate monopoly carrier, would still have to be interconnected to ensure that calls could be made between the customers on each network. While competition in telecommunications is a relatively recent phenomenon, work on the interconnection of networks, usually at the international level, has been in place for more than a century through organizations like the ITU and its predecessors, and similar regional bodies.

The introduction of competition for telecommunications services means that interconnection often now take place between networks which compete for customers in the same geographic area. Nonetheless, interconnection remains a concept which is quite distinct from the concept of access. There are markets where competitive carriers exist and interconnect their networks, but where there is no mandated provision for access. Such an approach is appropriate where there is a general shortage of local access services to meet the demand from consumers. A legislated access right frequently removes the incentive for a new carrier to provide local access services and allows a new entrant to the market to pursue only the market for long-distance and international calls. By providing only interconnection, the connectivity between competing networks is achieved, while still maintaining an incentive for new carriers to provide local access services. Mandated access is most appropriate in well serviced markets, where there would be inefficient duplication of infrastructure if new carriers were required to build direct connections to consumers in order to enter the market.

When two electricity networks are connected together, it is done for economic purposes such as load balancing or to utilize cheaper generating capacity. It is not done for the purpose of maintaining connectivity between the networks; as occurs with telecommunications networks. The consumers connected to an electricity network will be indifferent to the origin of the electricity that they consume and they will be interested in the only price and reliability advantages which may be available to them.

The traffic resulting from the interconnection of two telecommunications networks also has quite different characteristics from the traffic generated by the provision of access. Except where there are significant market distortions(2), the traffic between the two networks will generally be symmetrical with the same volume of traffic in each direction.

This symmetrical flow of traffic between the networks tends to balance the charges for each carrier's traffic and hence, the carriers will be much less sensitive to the level of the interconnection rates imposed by each carrier. By contrast, the traffic generated by the provision of access is normally highly asymmetrical and the rates charged for handling this type of traffic are usually extremely contentious.

This is not to say that competitive issues do not arise with interconnection. When two or more carriers compete in the same geographic market, consideration obviously has to be given to the relative market power of each competitor. A small new network which is not interconnected with a much larger incumbent network is likely to fail in the market. The incumbent is under no such pressure and may have an incentive to avoid interconnection for that reason. Furthermore, this effect is related to the market power of the incumbent carrier (essentially measured by its market share of local access services) and does not diminish with increases in the level of competition in the market for access services or with the deployment of competing infrastructure.

The only thing that is likely to diminish the power of an incumbent local access carrier over interconnection is a loss of market share which, in the absence of regulatory intervention, will rebalance the negotiating power of the parties. The existence of a competitive market for local access services alone is not sufficient to achieve this. However, once interconnection has been provided to one new competitor, further new carriers can interconnect with the first new carrier, which would normally want to improve its market position through increased volumes, and the incumbent carrier loses much of its market power(3).

The symmetrical nature of the traffic also creates an expectation that the charges should also be symmetrical(4). Although this expectation is not entirely justified, it makes any attempt to misuse market power, through the application of highly asymmetrical charges, much more visible.

The need for interconnection is closely associated with use of the number spectrum. These numbers represent the unique addresses for each service on the network. Irrespective of the availability of number portability, each number can, at any given time, have only one location. While it is possible for competitors to provide competing direct connections on which customers can originate calls, there is generally only one location on which an incoming call can be terminated. It is therefore necessary that any interconnection obligations apply to those who have been allocated part of the national number spectrum. In general, this will mean carriers and service providers, but as number allocations can also be made directly to consumers or end-users, either directly or effectively through the provision of number portability, the interconnection obligations should apply more broadly. By way of contrast, access requires the ownership of infrastructure and access obligations would apply to a much smaller group.

There are therefore two distinct reasons for regulatory intervention in the telecommunications industry: to provide for call completion to maintain the connectivity of the overall network; and to promote competition in a market through the provision of access to infrastructure which cannot be economically replicated. The first is fundamental to the telecommunications industry and has been achieved by the industry, with little regulatory intervention, for more than a century. The second arises from the more modern phenomenon of competition in telecommunications markets. The approach to regulating this issue depends on a range of complex issues, including the market structure, the level of competition in the market, and the political aspirations for infrastructure development.

2.2 THE PRACTICE

To complement the theoretical treatment given above, it is worth considering the practical realization of access and interconnection in an environment with a monopoly carrier such as Australia in 1991(5).

The experience in opening the Australian market to competition serves as an illustration. When Optus entered the Australian market in 1992 to provide long-distance services it needed three basic services from Telstra: an originating service to enable the existing customers to make calls to Optus; a transmission service to enable Optus to connect its switches together into a network; and a terminating service so that Optus could deliver calls to the destination customers. These requirements are not unique to carriers. They were repeated, in slightly different form, when switched resellers(6) entered the market.

The originating service is an *access* service as described in this paper, in that it is necessary for competition rather than connectivity reasons. It enabled Optus to provide long-distance services to existing customers without having to connect directly to those customers. This service enables a customer connected to the Telstra network to make a long-distance call through the Optus network in one of two ways: either by first dialling the Optus access code or by arranging to be preselected to Optus so that all long-distance calls would be routed automatically through the Optus network. It connects the calling customer through the Telstra network to a point of interconnect between the two networks. A similar service was offered to switched service providers(7).

Because this service was used for access and the customer is billed by Optus for the call, the Optus network is also supplied with the CLI [calling line identity – the telephone number] of the calling customer when the call is established. CLI would normally be provided between networks, but for operational rather than commercial reasons. Separately, Optus is also supplied with the billing name and address of the customer.

An originating service can also be supplied as an interconnection service in the case of calls that are charged to the called customer. In these cases there is no need for information to be provided to enable the calling customer to be billed as the calling customer, if billed at all, is billed by the originating carrier.

The transmission service provided by Telstra was necessary to enable Optus to introduce a long-distance service well before it could install its own transmission capacity throughout Australia. It was largely the same as the transmission services which Telstra provided to its other customers, except that its prices were subject to the Minister's direction on intercarrier pricing(8) rather than Telstra's retail tariff. Optus was a general carrier under the Telecommunications Act 1991 and was entitled to, and did, install its own transmission capacity. Within a few years, Optus had installed major transmission links between the capital cities. Its dependence on Telstra for transmission services had reduced considerably. Eventually, Optus may be completely independent of Telstra in this regard.

Obviously, transmission services are provided to increase competition rather than to achieve connectivity. However, it is not clear that these services were provided as part of an access regime which sought to avoid the uneconomic duplication of infrastructure. The fact that Optus proceeded to duplicate much of this infrastructure would suggest that access was mandated simply to allow Optus to enter the market at an earlier time than it could have achieved using its own infrastructure. There were also pressures from the Government of the day to duplicate infrastructure. Optus and Vodafone were required to introduce network based competition: something that was forgotten in the subsequent debate in Australia over the aesthetics aerial cables and mobile telephone towers.

Vodafone was also provided with transmission services by Telstra and, to a lesser extent, by Optus but the circumstances were a little different in that Vodafone did not hold a general carrier licence and was unable to install its own transmission links except through the use of radio technology.

A telephony terminating service is an interconnection service as described above, in that it is required to maintain the connectivity of networks. It enabled Optus to terminate long-distance calls, and later local calls, into the Telstra network. It connects a call from a point of interconnection between the two networks to the called customer in the Telstra network and thereby enables the called customer to receive calls from customers on the Optus network. It also enabled all three carriers to terminate calls from their mobile networks into the fixed network and the other mobile networks.

In an environment where *interconnection* is the only consideration, access would not be mandated. The only requirement would be for each carrier to provide a terminating access service(9). These are exactly the circumstances which exist in Australia for the interconnection of the various mobile networks and the interconnection between the mobile networks and the fixed networks. It is only between the fixed networks, where competing long-distance services are available, that access, in the form of an originating service, is provided.

3. PRESELECTION, DIAL CODE ACCESS & NUMBER PORTABILITY

Preselection and dial code access were concepts originally developed in the US market. During the 1980s the US telecommunications market was partly deregulated with the introduction of new carriers and the break up of the AT&T network. The RBOCs, or local telephone companies, were formed with a monopoly on the provision of local service, presumably because it was considered to be a natural monopoly, and a prohibition on the provision of long-distance services. The long-distance carriers competed against each other but were prohibited, at least in theory, from providing local service. Similarly, the local telephone companies were prohibited from providing cable television services and the cable companies were prohibited from providing telephony services.

In this environment, where an artificial barrier had been interposed between the markets for the supply of local and long-distance telephone services, it was necessary for each customer to choose a preferred long-distance carrier in order to be able to make long-distance calls. Preselection was the technological solution to this problem, which was created by the regulated structure of the industry, and every customer had to choose a preferred long-distance carrier or have one arbitrarily allocated by the local telephone company. The situation was different in other countries, such as Australia, New Zealand and the United Kingdom where the market was not subdivided into local and long-distance. All carriers, and the numerous service providers, were free, although not necessarily able, to compete in all markets. Preselection in these countries was a mechanism to accelerate the introduction of competition into the long-distance market. It did so by giving new carriers to the established base of local access customers, as it had in the USA. However, as the carriers providing local access services, also competed in the long-distance market there was resistance to its introduction.

Australia, under government direction, introduced preselection for the second carrier fairly early(10). As in the USA, there was a preselection ballot. However, unlike the USA which allocated the non-respondents proportionately between the long-distance carriers, non-respondents continued to receive their long-distance service from their local carrier. In the UK and New Zealand, where preselection was not initially mandated by government, dial code access was the only mechanism available for several years and preselection ballots were not held. Australia did to introduce preselection for additional long-distance competitors until 1997.

It can be argued that access, either in the form of preselection or dial code access, is necessary because single line customers are not prepared to change their telephone number, and are therefore unable to use the services of a competitive service provider. However, cable TV operators are now duplicating much of the customer access network, so it would appear that the customer access network may not be the monopoly that it was previously believed to be. In an environment with competitive customer access networks, number portability may be a more important issue than access in the development of competition in telecommunications.

The other factor that needs to be considered is how many genuine single line customers remain.

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In other words, are we looking at the right market? In Australia the size of the mobile market is fast approaching half the size of the fixed line market and the number of mobile services is almost equal to the number of metropolitan households. In other words, the mobile networks are fast becoming realistic alternatives to the fixed networks for long-distance calls. This further undermines the market power inherent in the (fixed) customer access network.

This means that at least three mechanisms are working to reduce the market power inherent in the incumbent carrier's customer access network: its duplication by cable network operators, the competition available from mobile networks, and preselection and/or dial code access. The continuing need for preselection to be a mandatory access requirement is questionable in these circumstances.

A comparative table of access and interconnection characteristics, including comparisons with related retail services, is included below. It summarizes the sources of market power for each service and the extent to which a competitor may find or create substitute services. The particular significance of the terminating service in an open competitive market will be apparent from this table.

4. REGULATED PRICES

The major regulatory intervention in a telecommunications market is likely to be in the setting of terms and conditions for access and interconnection services. A regulator must achieve a delicate balance by setting prices which are neither too low nor too high. Low prices may discourage investment in telecommunications infrastructure which may lead to a gradual degradation of existing services and a lack of new and innovative services. High prices however, may have the effect of stifling competition and perhaps of encouraging uneconomic duplication of facilities.

The balance that needs to be struck between these two alternatives will depend greatly on the underlying objectives, which are often not stated explicitly, of the regulatory regime. These objectives differ between countries not least because of differences in economic development and culture. The continuing debate about the best method of determining these charges is, at least in part, a manifestation of these differing objectives.

Notwithstanding the differences in objectives which may exist in different jurisdictions, there are some basic insights that can be drawn from an understanding of the distinctions between access and interconnection.Access and interconnection services often appear to be mirror images of each other and the mistake is often made that this should lead to similar, if not identical, prices being mandated for these services. Given the different economic functions that access and interconnection serve, this is not necessarily appropriate.

In the case of telephony services, the revenue that the local access carrier receives will be the combination of the access charges for outgoing calls and the interconnection charges for incoming calls together with the retail local access charges. This revenue will provide the incentive (or lack of) for investment in the local access network.

The long-distance carrier will see the access charges and the interconnection charges together with its own costs as a disincentive to compete in the long-distance market. However, it is able, at least over time, to connect directly to the customer who originates the call and to substitute its own costs for the access charges of the other carrier.

For that reason, a better outcome may result from the application of different charges for access and interconnection services. This is not simply to compensate for the generally slight differences in cost between the two services, but also to allow for the greater capacity for access to be provided through substitute products.

Whatever the objectives of a regulatory regime, the regulator will never be absolutely certain that the prices which it sets are absolutely optimal to achieve the desired objective. There will always be a degree of uncertainty. If the charges for access services are set at the higher end of the range of uncertainty and interconnection charges at the lower end of the range, the incentive to invest in local access infrastructure will be largely unchanged for the local access carrier and increased for the long-distance carrier. The lower interconnection charges will also increase the incentives for competitive networks to be established, albeit with some reduction in the incentives for simple long-distance bypass.

From another perspective, this amounts to the application of price setting arrangements which more closely reflect the underlying cost of the service on those services, such as interconnection, which are not subject to simple market substitution. For example, it might be desirable to use a cost based pricing technique, such as Long Run Incremental Cost, to determine interconnect pricing, while applying a market based technique, such as Efficient Component Pricing, to the determination of access pricing.

The degree to which these price differentials should be applied depends on the degree to which investment in local access infrastructure needs to be encouraged. At one extreme, those countries that have chosen not to mandate access services have placed a very high value on the development of the local access network. They have effectively left the price of access to be determined by general competition law(11) or by the market through the cost of duplicated facilities or substitute technology.

Even where there is less concern about local access infrastructure investment and the major objective is to encourage competition, the differential between the charges for access and interconnection should at least represent the degree of uncertainty of the regulator in determining the appropriate level of charge. To do otherwise could put future local access infrastructure in jeopardy and place an undue and inappropriate responsibility for long-term industry onto the regulator.

5. CONCLUSION

Access and interconnection, while superficially similar, represent two very different concepts in telecommunications. They have quite distinct characteristics which must be understood before a satisfactory regulatory environment can be developed. A regulatory regime which does not recognize this distinction is likely to be clumsy in operation and liable to produce unsatisfactory results.

Characteristic	Type of Service	Source of Market Power	Substitutable
Access	Originating Service	Quantity of local access services moderated by the quantity of any competitive local access services	Yes
Interconnection	Terminating Service	Unique telephone numbers moderated by the quantity of competitive local access services	No
Consumer	Local Access Service	Quality of local access service moderated by the quality of any competitive local access services	Yes
Consumer	Local Call Service	Quantity of local access services moderated by the quantity of any competitive local access services	Yes

Table - A summary of the Characteristics of Access and Interconnection services and Comparable retail services.

1. A simple distributive cable television network is an exception which, in this respect, has more similarity to a water or electricity distribution network than to a telephone network.

2. Market distortions are not uncommon, with the international settlement rates being one more major source of distortion. Differences in the retail prices in different countries result in an imbalence in the flow of traffic in favour of the lower priced market. There price differentials also lead to arbitrage operations such as call-back services which create further imbalence.

3. This would not generally be a particularly efficient method of interconnection, but the threat of interconnecting through an intermediary carrier should be sufficient to encourage the incumbent carrier to provide direct interconnection.

4. The services provided by each network may be different and there may be different costs and risks associated with each network. The interconnections of rural and urban networks is a good example of such cost asymmetry.

5. There were actually three carriers in Australia at theat time. with varying statutory monopolies: Telecom Australia had a monopoly on terrestrial services within Australia, OTC(A) had a monopoly on international services and AUSSAT hada monopoly on the use of satellite technology within Australia. All these monopolies were removed over the period 1991 to 1997.

6. Switched ressellers obtained transmission links from carriers and used their own switches to create a switched network and provide call service to customers. Simple resale was a commercial transaction which involved only the resale of switched calls without the provision of any network infrastructure.

7. Dial code access only with no preselection.

8. Telecommunications (Interconnection and Related Charging Principles) Determination No. 1 of 1991, made pursuant to section 140 of the Telecommunications Act

9. Leaving aside the logical reversal which occurs with calls that are charged to the called party.

10. The second carrier, Optus, commenced long-distance service in November 1992 and preselection was available from July 1993. The preselection ballots followed six months after the introduction of competitive long-distance service in each. All ballots were completed by 1996.

11. New Zealand being the pre-eminant example.

The Local Dimension in Global Competition

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Abstract. The British Telecom-GTE-Worldcom competition for MCI implies a corporate strategy for building the global telecom giants of the future. The strategy consists of acquiring major local companies as anchors in each of three major regional markets: the European Union, North America, and Southeast Asia-Western Pacific. The monopoly profits of these local companies will decline as competition increases, but will be the primary sources of funds for technology-enhancing investments and penetration of new markets. The local companies' customers will also serve as captive markets for innovation in services. The Regional Bell Operating Companies (RBOCs) in the U.S., because they are large, profitable and private, are likely to function as nucleating factors as this strategy plays out globally. The rationale for this strategy is explained, and the implications for the individual RBOCs are explored in light of their recent performances.

Introduction

The events surrounding the MCI acquisition have resulted in varied reappraisals of the US and global telecommunications markets, the near term prospects for their evolution, and strategies for global competitiveness. It is notable that Sprint seems to be quietly adopting a similar approach; Cable & Wireless's current interest in acquiring Sprint suggests the same orientation. On the other hand, the discussions of strengths and strategies in the global telecommunications market appear to me to ignore the crucial role of the local carrier – the only reasonably secure source of high profits in the near term. Recent experience at state and national levels in the US and Canada in measuring the productivity and profitability performances of telephone companies persuade me that in the next decade, the profits and the customer base that local service provides will be critical in the development of the global telecom industry, because many of the habits of mind of regulators will be carried over into the near future. This, in turn, guarantees that the monopoly profits and protection of local (or national) monopoly will decline slowly, rather than abruptly, in the US and other countries where deregulation is proceeding. An example of similar opinion concerning global competition in other industries appeared in "Analysis: Boeing, a Giant in Jets and Foreign Policy" by David E. Sanger in the New York Times, December 17, 1996, where the foreign policy dimensions of the Boeing/McDonnell-Douglas merger are recognized and discussed. If true, this fact will condition, and in important ways, determine the path of the international telecommunications market in the next eight to ten years, and thus will strongly influence the form of the global telecom companies that emerge. Much of the reasoning on which these opinions are based derive from empirical evidence in Norsworthy's written testimony filed with the CRTC, FCC and state regulatory agencies, and in other papers prepared jointly with several colleagues, as cited in the references.[1] However, the opinions expressed here are ours, and are not endorsed by any sponsors or collaborators in earlier work. Finally, it should be very clear that we do not *advocate* the politico-economic environment that is an important premise of this paper, nor its consequences. But we do expect that the future will unfold to reveal a world very much like that outlined here, with producer-oriented politics-driven localism only gradually giving way to consumer-oriented technology-driven globalism. My optimistic view is that the transition will largely be accomplished in the next eight to ten years.

The paper is organized as follows. In the first section, the empirical evidence is presented, based on cost, productivity and technology stud-

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[1] See references.

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ies of US telecom companies. The cost evidence is used implicitly as the basis for expected costs in the near future in developed countries in Europe and East Asia. In the second section, the implications of technology and cost for politico-economic decisions in the Asia, the EU and the US are explored, and the general regulatory pattern of the next coming decade is explained. In the third section, I outline the optimal strategy that large international telecom companies are likely to adopt when they perceive their decisionmaking environment to be roughly that which I outline. In the fourth section, I discuss the prospects of the Regional Bell Operating Companies (RBOCs) and GTE in the market for global telecommunications ownership-based alliances.

I. Corporate Decisionmaking Environment in the Telecom Market in the Next Decade

These elements are listed to make clear the basis for the analysis and strategy formation that follows, not to hedge that position. Some of the elements that follow are little more than common sense applied in the light of the technological scenario developed in the preceding section. While individual elements may be debatable, I believe that their concatenation represents the most likely scenario for the near future, and that the strategic implications are not sensitive to minor changes in the environment that I postulate here.

a. Major Elements

1. Local US telecom markets will be open in principle but only gradually competitive in practice, and will continue to provide substantial though declining monopoly profits. In 1995, the seven Baby Bells alone -- the Regional Bell Operating Companies or RBOCs -- enjoyed a cash flow exceeding $20 billion from their sales in regulated markets. The FCC seems to plan to leave the management of emergent competition to the states, (which is *almost* to say, to the Local Exchange Carriers, or LECs). The LECs have successfully lobbied their respective state regulatory authorities into decisions concerning price caps and special restructuring expenses that leave the companies generally in extremely favorable positions. (I assert this descriptively, not prescriptively. In my personal view, it would be better for users of telecom services, if the FCC were to enforce competition in local markets. The decline in the market value of the RBOCs' common stocks after the passage of the Telecommunications Act of 1996 in February, and the sharp recovery after the FCC's announcement some details of its proposed implementation in August suggest that the stock market shares this view to some degree.)[2]

2. Wireless telephony will grow rapidly. However, it will not be a competitive alternative for routine telephone services for residential and small business concerns for at least five years, and thus will not seriously decrease the local carriers' effective monopolies of local markets. As a consequence, competition in the local market will be based on physical connection to the global network for the next eight to ten years.

3. National and international markets will be wide open from the US, as at present.

4. Alliances in the international telecommunications industry will be meaningful only when there is substantial stake in joint profits. This means that, in particular, the alliance between AT&T and Kokusai Denshin Denwa (KDD, the long distance successor to the former monopoly carrier in Japan) does not necessarily foretell "the alliances of the intermediate future.

5. European telecom policy will for the next few years concern itself with protecting national markets and the EU market for telecommunications.

6. Japan will effectively open its national telecom market only slowly. This manifestation of its xenophobia, as well as the negative reaction to Japan from the EU and residual fear of Japanese hegemony in southeast Asia, may well mean that Japan will not play a dominant role in the Pacific Rim in the near future.

7. China will continue to retard the effects of the telecom revolution in its economic and political society. While its domestic market will be a magnet, its companies will not provide the nucleus of a global giant. If anything, announcements since the death of Deng tend to suggest that this scenario is more likely than before.

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[2] The RBOC common stocks as a group fell from February to August 1996 as the market (S&P 500) rose, and then outperformed the market from August through early February 1997.

b. Other Factors in the Telecom Market

Cable services may be the long shot, if two-way modems for the home soon become sufficiently inexpensive. Such a technological development would not change the outline of global strategy, but it would expend the number of options for globalization by making, e.g., Time Warner and TCI major potential candidates for the local North American footprint for telecom giants. Cable companies are typically franchised on a local basis in the U.S., and so provide that vital down-home link to the local polity.

One might build a case for current electric power distribution companies as telephone service providers, based largely on their ownership of right-of-way and poles which are the key elements of the distribution network. However, I think it is probable that there is too great a cultural gap between electric power companies and the telecom industry, particularly in marketing and in the accustomed pace of technological change. It would be nice to see this happen; competition from this quarter would weaken the role of monopoly profits from local telephone service.

Is a manufacturing arm necessary to a global telecom strategy? In my view, probably not. Telecom hardware manufacturing has become more, not less, competitive in the last decade. Innovations may be expected to come from some small as well as large companies. The commonality between telecom equipment manufacture and the R&D and manufacture of computer peripherals is enormous; indeed, the line dividing them either doesn't exist, or moves erratically. Relying on internal innovation or adaptation of new hardware would probably retard the global telecom companies.

The deregulation of telecom in Canada is not as advanced as in the US, but Canada will not be saddled with simultaneous federal and local regulation, as is the U.S. After an initial period that allows for privatization of the major companies – now partially or wholly owned by regional governments – the independent local companies in Canada may be attractive for cross-border linkages with US RBOCs and, if it survives, GTE. And as noted above, advances in technology or merging with a large telecom company could vault Time-Warner or TCI into the role of significant competitor in local markets.

II. The Strategy

This description of the national and international telecom environment leads to a strategy for the global competitors that depends critically on a local presence in three major markets: the European Union, North America, and the western Pacific Rim: thus a three region strategy is key for the next several years. The need for a local "footprint" in each area derives from the political and economic realities that remain unchanged (although they certainly adapt) by the telecom revolution. *The economic reality is that the basic local telephone market provides good jobs and economic profits. The political reality is that these jobs and profits invariably find their way into forms that benefit local (in the global perspective, national) politicians.* The national governments, which will initially control the negotiations, will seek to protect and advance the interests of their "clients". To be successful in the world market, the global company must have a strong advocate in each major policymaking region. Hence the necessity for a three footprint strategy. Other regions, such as Eastern Europe, Central Asia, Latin America, and Africa will initially be dominated by the needs for expanded local service and connections to one or more of the three major markets.

By itself, this "localism" (by global standards-–nationalism, as it is conventionally viewed) would lead to continuation of national monopolies. But there are extreme "economies of density" that prevail in telecommunications. These economies come about because there are very large fixed capital costs in the telecom network, and very little additional cost associated with additional traffic. These low costs set up a powerful counterforce to high international access charges, and to ultimately too high local telephone rates. Moreover, a medium-sized country cannot isolate itself from the telecom revolution while embracing the manufacturing and financial revolutions it has spawned. So the monopoly profits in local telecom service, while declining, will continue to play a dominant role in the global industry for perhaps the next ten years.

The local footprint also provides a customer base for experimentation with and development of new telecom services, a route into cable TV, high bandwidth data services (Internet), funding for R&D and for "content" services (e.g. education, entertainment). The learning effects, in both cost reduction and marketing savvy, make it less costly to extend the new services to other markets. It is clear from the US experience that long distance service is easier to enter for the local company than local service is for the long distance company. Long distance companies by themselves will not be able to afford R&D on a sufficient scale.

The Bellcore case illustrates this point clearly. A major portion of Bell Labs, Bellcore was spun off during divestiture to become a jointly owned nonprofit research arm of the RBOCs. Bellcore's budget was dominated by projects shared by all the RBOCs, including software and hardware applications associated with the new generation of switches mandated by the equal access requirement for long distance. The RBOCs cut the budget beginning in the late 1980's, while expanding their own separate spending on R&D. In its recent divestiture, AT&T again spun off most of the remainder of Bell Labs as part of Lucent. Bellcore has recently been sold off by the RBOCs. This case history has lessons for alliances in the global telecom industry: generic projects will in general fall to more parochial, i.e. profitable, alternatives.

The MCI/British Telecom (BT) merger to form Concert foreshadows the international telecom giants of the early 21st century. It combines BT's strong local monopoly base (which is open to competition) with MCI's marketing and international experience. Now imagine this company merging with a major US RBOC – or GTE – and with a major local player in the western Pacific: Australia/New Zealand, Taiwan, Hong Kong or Korea. Such a configuration would provide a stable revenue basis for experimentation with services and new technology, with crucial political support – and hence market entry – in each of the three major regions.

What is the mechanism for building a competitive global telecom company? The giants to emerge in the near future will be nucleated on existing international long distance companies such as MCI (was), AT&T, Kokusai Denshin Denwa (KDD), and Sprint/Deutsche Telekom/France Telecom. They will include some form of profit-sharing alliance with a local monopoly in one of the following major national markets in the EU: France (France Telecom), Germany (Deutsche Telekom), Italy (Telecom Italia), UK (British Telecom). They will probably include a similar alliance with a local monopoly in one of the following major national markets in the western Pacific Rim: Australia/New Zealand, Hong Kong, Korea, and Taiwan. (It is hard to imagine NTT in a consortium that does not include KDD, so NTT is probably not a potential partner for any other international long distance carrier. The PRC's impending takeover of Hong Kong makes Hong Kong Telecom a problematical prospective partner.)

As an illustration of analysis based on the three-region strategy, consider the present status of AT&T. The BT/MCI merger illuminates its inactivity in establishing a local footprint in North America. According to the strategy outlined here, ideal partners in the US for AT&T include GTE, BellSouth, and Ameritech (rumored to have been left at the altar by MCI). Slightly less desirable – because of its current financial structure – is Time Warner. These three companies are complementary with AT&T in that all need the strong national and international long distance linkage, and AT&T sorely needs a local footprint in the US. It is doubtful that the FCC would countenance a merger between AT&T and either of the Super-RBOCs, SBC/Pacific Telesis and Bell Atlantic/NYNEX. Either Taiwan, Korea or Australia/New Zealand[3] would provide the third regional footprint. Taiwan is particularly desirable – for AT&T and other global players as well, because it has a common language and informal connections with China.

III. The Cost and Technology Frontier for Telecommunications in the Next Decade

I first analyze the telecommunications environment of the major US telecom firms, then state the elements of what I believe to be the strategy that successful firms will adopt in that environment, and finally briefly survey their individual prospects.

The telecommunications revolution has been driven by technological changes that have dramatically realigned the costs of conventional telephone services, and closely related services, including data transmission, mobile phone service and paging services. This industry is characterized by economies of size on both sides of the market. Economies of scale in production, derived largely from the increasing density of traffic on the local and international networks make the marginal cost very near to zero (until congestion sets in). The falling costs of national and international long distance have encouraged expansion of the customers' demand for service. But also on the demand side of the market, the phenomenon of critical mass has been at work, most visibly in the expansion of Internet connections by businesses and households. The critical mass concept comes from the fact that a communication medium's value increases as the number of people and enterprises accessible by that medium increases. This concept, referred to as "externality in use" or in consumption in some of the economics literature, is a feature common to most networks. The earlier diffusion of telephone service itself, of the automobile in association with the highway network, and of the growth of railroad traffic are all examples of the critical mass phenomenon.

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[3] With its recent reforms, New Zealand is probably too competitive as well as too small to provide a viable local presence by itself.

As a consequence of the effects of both supply and demand factors, the marginal cost of access to the local loop is now acknowledged to be quite small, although there is, not surprisingly, no consensus between the Local Exchange Carriers and the long distance carriers about the level of the costs. FCC hearings currently in progress will determine a cost basis for access charges that will largely determine the rate at which competition emerges in the markets for local telephone service. The introduction of new telephone services now is largely a matter of software- rather than hardware-based augmentation of the network. This characteristic of current technology is extremely important because it means that most of the costs of new product introduction are fixed, which means that the marginal or incremental costs of new services are near zero. Rather, the realized costs, and the strategic elements lie in the extension of service to new customers through marketing, where the long distance companies have more experience than the Local Exchange Carriers (LECs).

The future prospects for the LECs in the intermediate and long terms depend upon how they position themselves in the global telecom market. They must be allied with or part of the three or four global giants that will emerge in the next few years, because, for the most part, they lack the international network infrastructure and the competitive marketing experience for rapid extension of their services abroad. However, like major local telephone companies throughout the economically developed world, they have a major requirement for success: reliably high profits in the near and intermediate terms.

While it may be argued that the RBOCs were created equal in 1984, the ensuing decade has resulted in considerable dispersion of their individual cost performances, as described below.

IV. Prospects for the Major US Telecom Companies: GTE and the Regional Bell Operating Companies as Partners in Global Networks

If the three footprint view of global telecom strategy is correct, the RBOCs are ideal partners for aspiring global telecom giants: they provide the required local connection in North America, on a scale that guarantees a temporary flow of monopoly profits, and a captive test-market for new services and for new technologies. The increasingly deregulated markets for local services – voice, data, cable TV, etc. – is unmatched currently and in near prospect in any other country on such a large scale. The single most important economic lesson for the previously monopolistic major national telcos is likely to be marketing: AT&T's learning-by-doing has been described as "painful". The RBOCs are also accustomed to the comfort of monopolized markets, but will necessarily be learning new tricks in the coming years. Their individual performances and relative standing in 1995 are noted in the next section.

Performances of the RBOCs Since Divestiture

The period since the break-up of AT&T provides an excellent laboratory experiment for studying corporate performance. The seven RBOCs began as approximately equivalent heirs to the local customers and physical facilities – as well as the local monopoly franchises of the Bell System. Their respective evolutions since reflect their strategic visions and their individual successes with state regulators, as well as their adaptations to the rapidly evolving technological environment of telecommunications. Their dynamic performances are summarized in Table 1. There is not a great deal of dispersion in the growth of access lines of the RBOCs: Bell South leads the pack with a growth rate of about 3.5% and Ameritech trails. The effects of growth in access lines is largely based on factors external to the firm; the other factors describe the firms' performances. Annual cost per access line has grown rather slowly, compared to other industries' operating costs, but this is hardly remarkable in light of two other factors: annual growth in total factor productivity averaging 4.3% and about 2.3-2.5% lower inflation in input prices, compared to the national economy. By contrast, total factor productivity (or TFP) – an important measure by which the FCC gauges the performance of the RBOCs and other local exchange carriers – in manufacturing is 1-1.5% per year. Significantly, Pacific Telesis does extremely well by both measures. Its cost per access fell by about 0.2% per year, and its TFP increased about 5.4% per year. Further, Pacific Telesis had the lowest cost per access line in 1995, perhaps an indirect and partial measure of overall benefit to customers. The gross profit margin is reported because depreciation is part of cash flow, and is affected by regulatory allowances more than by economic considerations. Thus gross profit is one reasonable measure of corporate performance, and probably better than the rate of return on assets, which was regulated until the introduction of price cap regulation in 1991. Southwestern Bell Corporation (SBC), a mediocre performer by other measures, has by far the largest gross profit margin, and SBC is buying Pacific Telesis. This fact alone should serve to reject the notion that the telecommunications story is completely technology-driven.

When we examine the stock market performances of the RBOCs, the story is also a rosy one. Based on the conventional dividend discount model, the average annual rates of return for the RBOCs ranged from 18.7% to 21.5%, a relatively narrow range, but high compared to the market's performance for that same period – 13.4% – measured by the S&P 500. The performance of the RBOCs includes both regulated and unregulated services provided by the telcos, and removes effects some of the necessarily fictional accounting conventions incorporated in their reports to the FCC.

Ameritech

If the proposed combinations of other RBOCs are approved, Ameritech, which was rumored to have been jilted by MCI, may be the most vulnerable to take-over or (relative) secular decline of those remaining. Uniquely, it is land-locked geographically. Canada would be a natural place for Ameritech to extend its domain but the pace of deregulation in Canada, which is accompanied by privatization of several of the major companies, is likely to continue to lag. Economic growth prospects in its region lag both Bell South and US West, the other orphans. A white knight in the form of BT/MCI or AT&T or GlobalOne (Sprint/Deutsche Telekom/France Telecom) should be welcomed by shareholders and management alike.

Bell Atlantic/NYNEX

This merger is likely to face more rigorous objections from the FCC than the SBC/Pacific Telesis combination. Bell Atlantic has probably been the star of the post-divestiture decade among the RBOCs. It has innovated in services to business and residential customers, and in deal-making. Indeed, if NYNEX were nearly as efficient as Bell Atlantic, this combination could conceivably form the basis of a global telecom giant itself, as noted below, because a very large proportion of the US's international telecom traffic originates or terminates in the combined territories of these two RBOCs. However, NYNEX is the least efficient of the RBOCs in terms of operating cost per access line, and in consequence, it probably faces the most severe competition in its local telephone market of any of the RBOCs. More than the other RBOCs, NYNEX has enjoyed the fruits of monopoly power since divestiture, at least partly in consequence of its successful special pleading for extraordinary cost allowances before state and federal regulators. If the merger is approved, and Bell Atlantic's is the surviving management, the combined company's efforts to retain business in the NYNEX territory may depend on massive write-offs of NYNEX' assets – not because they are obsolete, but because, in a competitive market, they are probably vastly over-valued. If the merger is approved, Bell Atlantic/NYNEX may not be permitted by the FCC for a few years to combine with a global international company. However, NYNEX's efforts to enter the Asian market may establish a basis for the merged company to become an international competitor on its own. If that is the aim, it is critical for the company to establish an early foothold in either the Pacific Rim or the EU market, with the other to follow within, say, a year.

Bell South

Bell South may be the debutante of the year among the RBOCs. While has been rather conservative in innovations, and has revealed little international ambition beyond its forays into Latin America, Bell South is much beloved by state regulatory authorities, because it has charged very low rates for basic local service, drawing most of its profits from access charges. Economic growth prospects in its region are high, and state regulation has been typically quite conservative, i.e. rate of return-oriented. Combination with Ameritech or US West offers no special advantage beyond the basics of long distance service. Bell South's efficiency is about average. Bell South is financially sound, but not – at least not obviously – cash rich, as would be required to overcome US West's financial problems, or Ameritech's isolation. As a footprint in North America, with strong established business connections to Latin America through Florida, where a secondary battle for territory will take place in the next decade, Bell South is a prime candidate for combination with a global giant, such as AT&T, BT/MCI, or GlobalOne.

SBC/Pacific Telesis

Pacific Telesis arguably has been the Boy Scout of the RBOCs: the company invested most heavily in new technology and pioneered in bringing advanced services to its customers – and, in consequence, will likely be absorbed into SBC Corporation, whose chief virtue has been to amass financial wealth. Pacific Telesis is the most indebted of the RBOCs, with middling efficiency. SBC stands with Bell Atlantic as a most successful RBOC, despite its relatively low comparative efficiency. SBC/PacTel's critical window on the Pacific, high economic growth prospects in Texas, and advanced technological experience in Pacific Telesis make the company a prime candidate for combination with a global carrier. However, the FCC may mandate some period before another major combination involving the company is permitted.

US West

US West is a high cost producer of telephone services because its customers are dispersed over a large thinly populated territory. Its growth prospects are good in many parts of its territory, fair in others. The company *does* have a crucial window on the Pacific and physical adjacency to British Columbia, the most rapidly growing province in Canada. Its high cost per access line make US West a candidate for experimentation with wireless technology for telephone service, perhaps jointly with wireless TV. The company has an alliance with Time-Warner, which shows good strategic vision, but to date the alliance has borne little fruit. If Bell South is the first round draft pick for combination with a global carrier, US West is probably second. Its prospects seem more promising, if more risky, than Ameritech's.

GTE

GTE may emerge as a desirable merger or acquisition partner for a Europe- or Pacific-based company if it can bring down its costs of service. The company has many desirable characteristics: it is about as large as the RBOCs, it "owns" Hawaii in the mid-Pacific, it has a major presence in California, and its scattered local service entities provide local platforms from which to launch local telephone services competitive with the RBOCs themselves. However, according to conventional measures, GTE is a very high cost producer. Along with the "mom and pop" telcos, GTE, although in aggregate a large national company, has been allowed to charge a premium for its services, which are rendered mainly in disparate, thinly populated areas. (Hawaii is clearly an exception). The relatively permissive regulatory attitude may derive in part from the difficulty of determining the costs properly attributable to any particular GTE location. The company has been described as "harder to audit than the Mafia."

Sprint

Sprint is included in the analysis of local telephone companies because its acquisition of United Telephone puts it in a position similar to that of GTE: a strong if scattered local presence, and a well established long distance position. If its alliance with Deutsche Telekom (DT) and France Telecom (FT) matures into more significant ownership and strategic coordination, the Global One alliance could rapidly become a major international competitor. Perhaps this perception, as well as the direct potential benefits to itself, underlies Cable & Wireless's current effort to buy Sprint. In terms of the strategy outlined here, C&W, which already has scattered local presence in a large number of former British colonies, is a nearly ideal partner. Sprint's alliance with the EU companies may complicate the picture. It is difficult to imagine that DT and FT will move effectively and quickly to counter C&W's offer, principally because so much is at issue politically between their respective countries concerning the near future of the EU. But the lure of major global presence in telecommunications may overcome France's linguistic nationalism and Germany's conservatism.

As these brief summaries have shown, the RBOCs, GTE and Sprint are quite different from each other. The various potential international long distance companies are even more so, in their current capabilities, their national and regional regulatory environments, and their patterns of ownership and capital structures, especially because most have not revealed their capacities to compete or to move strategically. All of these factors will influence their initiatives and decisions, as well as their responses to the changing regulatory environments in the EU, the US and Asia. In my view, the decisions of the emerging global telecom giants will underscore the central role of local telephone service and the associated profits in globalization.

V. Prospects for the Near Future

How long will it take for the global telecom companies to emerge? Allowing for some reversals thereafter, the outlines will begin to emerge in the next one to two years. I think that some creative negotiations will soon take place – if they are not already in progress – between nationally owned companies (and their governments) and the existing long distance giants: Concert, AT&T, Sprint/DT/FT, KDD of Japan. These negotiations will be sticky. But a major stimulant – and irritant – to globalization of telecom services is the widespread and growing use of international call-back services based predominantly in the US. While FCC Chairman Reed Hunt is roundly cursed by the national telecom companies in Asia and Europe, his policy of pressing for reform of international interconnect charges has surely not caused crowds of foreign citizens to burn him in effigy. That policy – which has lit a firecracker under national telecom monopolies in Asia and Europe, and generally worldwide – consists in *not intervening* to control call-back services, whose providers are largely outside the US. (AT&T has recently unveiled its own callback service in Japan. See WSJ, Nov. 29, 1996, p. A4). Consequently, the FCC's policy can be defended on the principle of "letting the market work", which is harder to oppose in international policy forums than a specific intervention. If it continues to prevail, this policy of benign neglect may in the long run prove to be the most significant foreign policy initiative of the two-term Clinton administration.

In this view of the international telecom industry, it is hard to envision more than three or four major international players in global telecommunications in the middle years of the next decade. It is quite possible that some of the current national giants may not make the cut if they ignore the critical local dimension to global strategy.

REFERENCES

Norsworthy, John R., Show-Ling Jang, James C. MacDonald, Diana H. Tsai, Cecile W. Fu and Yi Jing. **Measurement of Productivity and Marginal Costs for Incentive Regulation of Telecommunication Services,** Report to the New York State Public Service Commission, Center for Science and Technology Policy, School of Management, Rensselaer Polytechnic Institute, January, 1993.

Norsworthy, John R. Chapters 2 (Overview and Framework for Analysis) and Chapter 5 (Audit of Affiliated Relations with Bellcore and Cost-Benefit Methodology) in **Focused Management Audit of Illinois Bell Telephone Company's Affiliated Transactions,** Frederick and Warriner. Report to the Illinois Commerce Commission, April 1993.

__________,"Analysis of Total Factor Productivity Methods for Measuring the X-Factor of the Local Exchange Carriers' Interstate Access Services," Appendix A in **Comments of AT&T, Docket CC 94-1, Price Cap Performance Review of Local Exchange Carriers**, January 11, 1996.

__________, "Responses to Issues for Comment," Appendix B in **Comments of AT&T, Docket CC 94-1, Price Cap Performance Review of Local Exchange Carriers**, January 11, 1996.

__________ and Ernst R. Berndt Reply Statement of Dr. John R. Norsworthy and Dr. Ernst R. Berndt, "Response to Comments of Local Exchange Carriers on Methods for Measuring the X-Factor for their Interstate Access Services," Appendix B in **Reply Comments of AT&T, Docket CC 94-1, Price Cap Performance Review of Local Exchange Carriers**, March 1, 1996.

__________, **Reply to Declaration of Melvyn R. Fuss**: in behalf of AT&T, Docket CC 94-1, Price Cap Performance Review of Local Exchange Carriers, October 3, 1996.

__________, **Evidence of Dr. John R. Norsworthy**, Prepared on behalf of the Public Interest Advocacy Centre for La Federation Nationale de Consommateurs du Quebec, National Anti-Poverty Organization, Consumers Association of Canada, Pursuant to Telecom Public Notice CRTC 96-8, Price Cap Regulation and Related Issues, Canadian Radio-Television Telecommunications Commission, August 30, 1996. 116 pp.

	Table 1: Dynamic Performance of RBOCs, 1985-1995				
	Growth of Access Lines	Annual Change in TC per Access Line	Total Factor Productivity	Relative Cost per Access Line: 1995	Annual Market RoR 1984-1995
Ameritech	2.21%	1.08%	3.33%	92.7%	21.3%
Bell Atlantic	2.30%	1.61%	4.77%	92.2%	18.8%
Bell South	3.48%	0.43%	3.91%	107.0%	19.2%
NYNEX	2.23%	1.15%	3.80%	117.9%	18.7%
Pacific Telesis	3.09%	-0.18%	5.37%	82.9%	21.4%
SBC	2.42%	1.31%	4.89%	103.1%	21.5%
US West	2.51%	1.35%	4.26%	104.2%	19.5%
Average: All RBOCs	**2.61%**	**0.96%**	**4.33%**	**100.00%**	**20.05%**

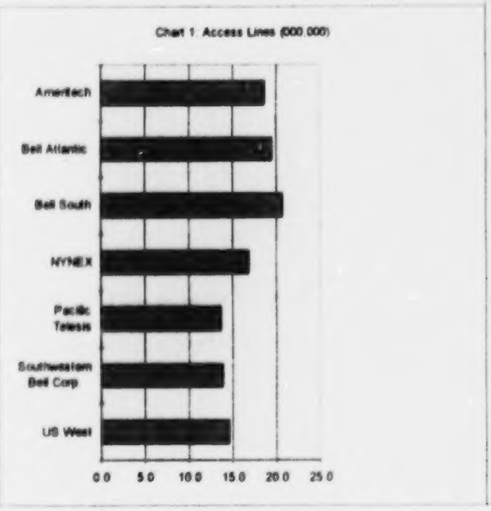
Chart 1: Access Lines (000,000)

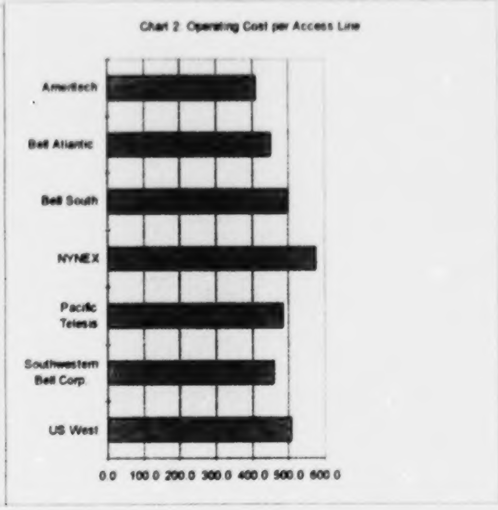
Chart 2: Operating Cost per Access Line

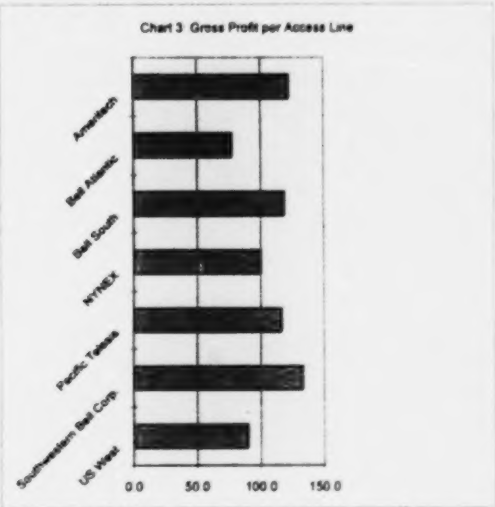
Chart 3: Gross Profit per Access Line

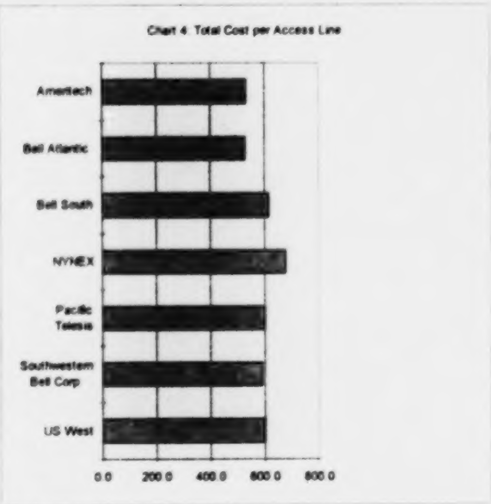
Chart 4: Total Cost per Access Line

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Cross-Border Telecommunications Investments: The Building Blocks

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1. ABSTRACT

The wave of privatizations that has swept the telecom industry in the Asia-Pacific region has resulted in unprecedented opportunities for investments in newly-established companies seeking to obtain and exploit licenses for telecoms installations. Market forces compelling consolidation have also generated opportunities for investment in private sector fixed-line and wireless operators established over the past few years. A cross-border acquisition or alliance in any industry creates legal challenges, but the telecom industry presents some unique risks and difficulties. This paper examines, from a legal and business point-of-view, the key "building blocks" for successful cross-border investments in the telecom industry.

2. INTRODUCTION

The early 1990's gave rise to an explosion of investment opportunities in the international telecommunications market, especially in the Asia-Pacific region. While privatizations effected through the capital markets may have generated the most attention, extensive opportunities for private investment were produced in the form of strategic sales of equity in previously state-owned telecom operators, and in the form of joint ventures with local companies to bid for and exploit new licenses. Even before they had developed global penetration strategies, many major telecom operators were quick to seize early opportunities thought to be unique or economically attractive, perhaps out of fear that market entrance barriers would be raised. Although the pace has abated somewhat, opportunities for telecom investment in the region are continuing to be generated, both from countries that were not at the forefront of Asian privatizations and from countries exploiting new technologies.

Now that some of those early investments have matured to the operational stage, a second wave of opportunities is emerging. Many observers believe that there are currently too many industry participants in some countries and economic efficiency will compel a series of mergers. For example, in the Philippines, there are now several private franchisees that are installing and operating fixed lines in various regions of the country, in competition with Philippine Long Distance Telephone, the former monopoly operator. Moreover, as global carriers refine and reassess their international strategies, some have determined to withdraw from some Asian telecom investments in favor of other regions or to seek synergies through other forms of investment or alliance. All of these factors yield in turn further opportunities for investment.

International investors can capitalize upon the initial experiences to enhance the overall quality of new transactions. A review of the early successes and failures of the first wave of cross-border telecoms investments highlights the importance of certain building blocks: first, there is no substitute for proper due diligence, including detailed analysis of the country in which investment is to take place and the proposed partners in the venture; and second, investors should understand the interdependence of the structural elements of an investment in a cross-border telecommunications venture, and the parties should clearly define those elements at the outset.

3. DUE DILIGENCE

An investment decision, of course, is only as good as the information on which it is based. A complete "due diligence" review for cross-border telecommunications transactions includes an investigation of the risks associated with investments in the target country. Typically, such a review is conducted by not only the investor's own personnel, but also by its accounting firm and international and local law firms, and sometimes by investment banks and special technical consultants. It is critical that all members of the due diligence team establish effective communications, so that facts uncovered by, for example, a technical consultant, are disclosed to other team members who are in a position to apprehend the significance of such facts to their specific areas of responsibility.

3.1 COUNTRY RISK

Broadly speaking, investors can view country risk associated with cross-border telecommunications transactions as arising in two categories: economic and political. Economic risk assessments in the telecoms context are no different than those in other cross-border transactions. General macroeconomic stability, the parameters of the target market, labor and supply issues, and currency risk and hedging strategies are among the most important elements to consider.

Political risk assessments are typically limited to analysis of the risks of violent coups-de-etat or civil wars. A more complete analysis, however, includes an assessment of the general stability and transparency of the governing regime, because major political shifts, substantial changes in government policy, or shifts in the tenor or substance of the telecommunications regulatory regime can also have significant impact on the value of any cross-border telecommunications investment. A related political risk, expropriation risk, is often minimized by analysts in the current "globalization" environment, but if one includes the risk of the revocation of a concession in a project finance transaction, or the dilution of foreign shareholdings in a telecommunications operator by governmental action, one can quickly see that the risk, although different from that of wholesale nationalization of assets, still warrants attention.

In many of the developing countries in which telecommunications projects are being undertaken, there are perceived to be greater political risks than are found in the industrialized West. The stability of the national government itself may be an issue of concern to equity participants. If a government is swept aside suddenly or undergoes a major political shift, foreign project participants will be concerned that the successor government may not share its predecessor's commitment to private telecommunications development. While in certain areas of private infrastructure development, some sponsors have been able to minimize political risks through direct agreements with the host country that are intended to survive changes in laws and government, the telecoms industry for various reasons has generally not witnessed such agreements between governments and project sponsors.

Investors' concerns might be partially addressed by procurement of political risk insurance from sources such as OPIC for U.S. developers or MITI for Japanese ones. Private political risk insurance is an alternative or supplement to host country undertakings. However, its availability may be limited. Some investors derive comfort from the "umbrella" of protection to be afforded by participation in the project of multilateral entities such as the IFC, the World Bank, US Eximbank or JEXIM. Such participation should offer a hedge, it is thought, against arbitrary action by a host country government that presumably would not want to offend these important institutions.

3.2 REGULATORY/ENVIRONMENTAL FRAMEWORK

One fundamental difference between project financings in emerging markets and those in the industrialized countries is the importance of identifying and dealing with the local law aspects of the transaction. The challenges here generally stem not so much from complexity of the local law, as simply from its absence. Many of the recent telecom investment opportunities have been in countries where the commercial and regulatory legal system is not fully developed. The consequence of this is that investors must place reliance on other mechanisms to reduce legal risk. An obvious element that foreign investors utilize for this purpose (if not otherwise required by local rules) is to seek a local partner, to serve as a guide to, and buffer against, legal uncertainties in the host country.

It is equally important, however, for investors to bear in mind local legal deficiencies when structuring and negotiating the arrangements with other shareholders and the target company. For example, in a country that affords limited or no realistic ability for judicial enforcement of contracts, the investor must place greater reliance on creating leverage in the inherent structure of the transaction itself. Thus, counterparties will be obliged to honor their contractual commitments because of economic compulsion rather than the threat of judicial enforcement. Perhaps establishing enforceable "put" or "call" rights with respect to equity shares upon another party's default might serve to deter the party's breaches more effectively than simple threat of suit for damages for the default. Or perhaps more elaborate "conditions precedent" to the making of a participant's equity contributions are called for than in other situations; or critical payments are to be held in escrow pending satisfactory performance of a counterparty's obligations.

In any event, the laws of the host nation will need to be analyzed carefully to determine the issues and risks to be addressed. Careful consideration must be given to a myriad of matters, among the more important of which are: (i) the convention, franchise or concession governing the telecom project and any related legislation, undertakings or guarantees of the host government given in respect of the project; (ii) the host country's regulatory structure that may govern the project -- especially requirements and tariffs relating to interconnection to the PSTN and other private fixed-line and wireless carriers; and (iii) any applicable host country import restrictions, exchange controls (including rights to repatriate dividends), limits on off-shore borrowing, restrictions on transfers in respect of interest, principal and dividends, taxes (especially withholding taxes on interest), labor laws (including rights to obtain visas for the investor's personnel), export controls, limitations on the creation and enforcement of security interests, local bankruptcy laws and insurance restrictions.

3.3 PARTNER RISK

Many developing nations require majority ownership of telecommunications ventures by a domestic entity, highlighting the importance of choosing wisely one's co-investors. Moreover, even where no such requirement exists, one obvious way of understanding and dealing with the domestic political process is to seek local participation in the project through domestic equity ownership. There are several layers of investigation to be undertaken, but the focus of the investigation should center on the capabilities, integrity and compatibility of the prospective partner.

Investment consortia are often formed among parties with complementary capabilities. Telecommunications consortia often consist of an "operator", an international telecommunications company with significant operational experience (and possibly with significant equipment and technology supply capabilities); perhaps one or more financial investors who view the venture as a promising passive investment; and a local partner with knowledge and experience of the domestic legal and regulatory environment (and possibly some telecommunications experience as well).

It is common for the local partner to have far less financial capability than the international partners; and that is true too for its level of sophistication about and familiarity with the expectations of international investors. Needless to say, these disparities generate friction at best, and at worst antagonisms fatal to the transaction. Consequently, one of the most important hurdles to overcome is creating a common vision among the participants, which reflects among other things the level of resources each participant is willing to commit.

Any co-investor should, of course, have the resources necessary to fulfill its financial obligations under the proposed venture. Investors should also investigate the potential of a prospective partner to fulfill future equity contribution obligations. Otherwise, future expansion may be constrained by a local partner's inability to fund future capital calls and maintain any legally mandated minimum ownership level. Initial contributions by local partners are often non-cash in nature, creating difficulties in allocating equity shares, as further noted below.

3.4 CURRENCY RISK

Currency risks are also an important issue in cross-border project financings. In many countries there may be limitations on the exchange of local currency into hard currency. Telecommunications projects in the Asian-Pacific region have generally been structured so as to produce local currency revenues for the private sector operator (whether from a revenue sharing arrangement with the national telecom authority, as in Indonesia or Thailand, or from direct customer billings, as in India and the Philippines). In some cases, operators with international long distance rights are able to derive U.S. dollar revenues from net settlement payments from international carriers. Obviously the latter situations are more attractive for investors both because they afford a greater probability of dividend repatriation in U.S. dollars, and also because they

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have an enhanced probability of successful financing from the commercial bank or capital markets.

Developers and lenders will want to scrupulously comply with any foreign exchange regulations and register their loans and equity investments for currency conversion rights when possible. In addition, project participants may wish to pursue direct exchange contracts or undertakings with the central banks of the host countries.

Of course, the basic risk of local currency devaluation cannot be ignored, and investors often seek "natural hedges" for this through the presence of other local currency obligations (*e.g.*, the purchase in local currency of domestically produced equipment).

3.5 LEGAL OPINIONS

Investors will want to obtain opinions of legal advisors as to the authorization, legality, validity and enforceability of the legal documentation, perfection of collateral security and other basic legal matters. In some cases, foreign investors will retain experienced international counsel to assist local counsel in defining the relevant issues and shaping the deal to conform to international market expectations. Opinions of local counsel are particularly important because they will highlight the particular risks arising out of the host country's legal system. Such counsel should be brought into the due diligence process at an early stage so that potential legal problems and risks can be dealt with at the structuring/negotiating stage -- rather than arising at the time the opinion is delivered at the closing of the transaction.

4. STRUCTURING THE INVESTMENT

Investors tend to analyze separately the various structural elements of cross-border telecoms transactions. The issues of capital contributions, distribution of profits, taxation, governance, ancillary contractual relationships, transfer restrictions and exit strategies are in fact interrelated. Structuring issues should be considered as a whole and negotiated together to optimize the allocation of risk over all aspects of the transaction. For example, the terms of control and the pattern of profit distribution may be used to discipline parties to fulfill their respective contribution obligations (and obligations under ancillary agreements). Ancillary agreements -- such as operational or technical assistance agreements -- may be used to supplement one party's control over the activities of the venture. Irreconcilable disagreements in governance may be resolved using previously agreed exit strategies. Taxation rules can affect the economics of any dividend distribution policy, and may impact the terms of transfer as well.

4.1 CAPITAL CONTRIBUTIONS

Parties can often encounter significant disagreement (especially when the local partner lacks capital and provides pre-incorporation services in lieu of cash) regarding the valuation of equity contributions (and this is aside from exchange rate fluctuations, which must be considered). Generally, these non-cash contributions are not of the type where an organized market exists to provide a valuation, and thus the determination of the value of the contributions is subject to the negotiation of the parties.

Any capital call structure should include a mechanism for disciplining venture participants who default on their contribution obligations. The straightforward approach, the dilution of equity shareholdings by a participant who fails to contribute while the others purchase new shares, may not be satisfactory for several reasons. First, many telecom regulatory regimes require domestic minimum ownership requirements that would be "tripped" by excessive dilution of the local partner. Moreover, and probably more importantly, the dilution remedy does not assure the venture that it will in fact be able to obtain the necessary amount of capital, as the non-defaulting shareholders may not or cannot assume the defaulting party;'s contribution. Finally, transfer restrictions may limit the ability of the other participants to dispose of their surplus shares arising from any assumption of the defaulting party's contribution. In such cases, a restructuring of the profit distribution or governance structure may be the only viable option; negotiation of those provisions is thus dependent upon the outcome of the capital call structure.

A related point is that investors must bear in mind any potential requirements of lenders to the venture -- if a project financing is contemplated -- for "sponsor support" in the form of additional contingent equity commitments or debt guarantees. Many commercial bank lenders are not satisfied with the debt-to-equity ratios that are acceptable to project sponsors looking to maximize their rates of return, and such lenders insist on additional equity contributions. Again, it is preferable if the investors anticipated such requirements at the initial structuring stage rather than being forced to reconsider the equity arrangements in the midst of a project financing.

4.2 DISTRIBUTIONS

In addition to the standard profit-allocation structure based on equity participation, distributions can be structured to provide additional incentives to the parties to undertake extra efforts to enhance the value of the venture, or simply to perform their obligations. Ancillary service agreements (described below) can also be used to supplement the earnings potential of the venture. If debt financing of the venture is contemplated, investors should note that lenders place significant restrictions on distributions, and often control revenue accounts to prevent the effective subordination of the debt to the venture's contractual commitments with its shareholders. If the equity sponsors desire to specify the distribution policy and business plan in detail at the outset, they should account for anticipated additional restrictions to be imposed by prospective lenders. All too often equity participants engage in protracted negotiations over dividend policy, and then find months later in negotiations with project lenders that their carefully-wrought compromises must be undone to accommodate lenders' concerns.

4.3 TAXATION

The structure of all economic elements of the transaction should be considered in conjunction with both the applicable tax regime in the host country of the venture and the tax rules of the home country of each of the sponsors. The primary economic considerations affected by tax policy are: how tax regulations affect the taxation of the venture's income; whether a more tax efficient structure can be achieved by routing the equity investment of the sponsors through a third country with favorable tax treaty exemptions; how dividends are taxed; how shareholder loans may be taxed; and to what extent dispositions of interests in the venture are subject to capital gains taxation in the venture's or sponsors' jurisdictions. In addition, if the venture is to be financed with offshore indebtedness, the sponsors should consider accessing the debt markets of third countries with favorable tax treaty exemptions to minimize or avoid any required "gross-up" payments to compensate lenders for withholding on debt service payments.

4.4 GOVERNANCE

The governance structure of the venture is often the most heavily negotiated aspect of any cross-border telecommunications transaction. For purposes of this discussion, there are three major aspects to governance issues: allocation of control, minority protection and dispute resolution.

Since local law often requires majority ownership by domestic entities, significant thought must be given to the means by which participants are given control relative to their contributions to the venture and relative to the value they can add to the venture. Internal governance methods, such as supermajority voting requirements or veto powers for important undertakings and changes in structure, or the right of the foreign investor to approve one or more of the nominees of the local partner to the management of the venture, are often used. Almost universally, strategic investors insist on a veto power over the determination of capital expenditure budgets and business plans. When the participant with telecommunications operations experience is a foreign investor, the structure of the board of directors (in the corporate context) is often skewed to give that operator/participant effective day-to-day control over the venture for a certain period, while the local partner retains certain veto powers over fundamental changes. In addition, the existence of ancillary service agreements such as those mentioned below can in practice devolve some of the control aspects of the venture to the foreign investor while the internal governance structure nominally favors the local partner.

Any discussion of governance issues must include dispute resolution. Rarely will all parties in a venture agree on all decisions, and often the disagreement can be such as to undermine the viability of the venture. Given that litigation in many developing countries is not necessarily an attractive option, alternate methods of resolving disputes may be required. As previously noted, the best mechanism for resolving or obviating disputes in the first place is for the structure of the transaction to compel performance by the parties of their contractual commitments. But sometimes this is not possible, or sometimes good faith disputes arise that are not susceptible to structural resolution beforehand. In such cases, arbitration can be an attractive option for foreign investors, because many nations are signatory to international treaties on the recognition and enforcement of foreign arbitral awards.

Arbitration may permit the foreign investor to circumvent the potential risks of the local judicial system, including lack of sophistication, arcane and burdensome procedure, and possible hostility to foreign interests. One must be cautious to ensure that all steps have been taken to minimize the risk of an arbitral award being reviewed by local courts, such as the waiver by the participants of any judicial review or the contractual submission to jurisdiction of courts other than those of the local country. In some situations this is not possible, so enforcement of a foreign arbitral award may be subject to a limited or even full review of the matter on the merits by local courts. Finally, it is usually the case that purely financial obligations (*e.g.*, a financial guaranty) ought not be the subject of arbitration, as it is thought that financial obligations are either due or not, and are not appropriately susceptible to the type of compromise that often is the product of an arbitration.

4.5 ANCILLARY AGREEMENTS

Telecommunications investment opportunities generally take the form of a joint venture to bid for and operate a government concession or an acquisition, either in the context of the privatization of a public entity or in the context of an investment in a private telecommunications operator. The traditional investigation of the terms of the concession (in the joint venture context) or the background of the target (in an acquisition context) should be supplemented by an analysis of the interdependence of the terms of the primary investment mechanism and any ancillary relationships, such as goods and services supply agreements, technical assistance agreements (the foreign partner promises technology and/or personnel for a specified period), interconnection or traffic agreements (the foreign partner promises to carry voice or data traffic for customers of the venture) and licensing agreements (for technology and/or trademarks). These ancillary agreements can be used to enhance the profitability of an investment through preferential pricing, or give a foreign investor additional control over the actions of the local partner. One should note, however, that there may be legal and financial limitations on deviations from arms-length pricing.

When partners play multiple roles (such as equity participant and equipment supplier), competing interests among the venture partners, and even within the different departments of the sponsor itself, can ensue. For example, the financial department of an equity sponsor who is providing technical assistance to the venture may desire the technical assistance agreement to extend for the life of the venture, regardless of the economics of the agreement itself, simply to ensure the venture maximizes the value of the technology transferred. A foreign investor should consider beforehand the extent to which its various contractual arrangements are linked to prevent, for example, unintended obligations under an ancillary agreement following the termination of the primary relationship. In the absence of approval of ancillary contractual arrangements prior to investment by the foreign participant, foreign investors should pay close attention to the venture's contract approval mechanism and any legal constraints on the activity of "interested" management personnel.

4.6 TRANSFER RESTRICTIONS

One of the primary concerns of a foreign investor in telecommunications transactions is the identity of its partners. First, one wants to ensure that all counterparties are creditworthy entities, both to ensure proper performance and to provide appropriate enforcement leverage in the absence of proper performance. Second, a party does not wish to pursue a major investment, and possibly share critical financing and technology, with (at best) strangers or (at worst) enemies, nor surrender negotiating leverage to a counterparty under threats of undesired transfers. Often legally imposed restrictions are sufficient to accomplish this goal, or in the alternate, current or prospective lenders will insist the shareholders be obliged to maintain their ownership. If this is not the case, the balance to be struck in designing appropriate contractual transfer restrictions is between the desire on one hand to bind the other participants to remain involved and the desire on the other hand to be free to exit the venture whenever it is no longer desirable to continue.

Investors should keep in mind that lenders tend to restrict the withdrawal rights of the shareholders of any venture, to preserve the technical and financial viability (and thus the debt repayment ability) of the venture. While drafting these provisions, an investor should contemplate the possibility of transfers of control of a shareholding subsidiary by its corporate parent, and incorporate into the terms of the joint venture agreement parallel restrictions on the ability of the parents of the shareholders to transfer their interests in the shareholding subsidiaries.

4.7 EXIT STRATEGIES

Investors in a cross-border telecoms venture should clearly stipulate early on the means by which they can exit the venture. The terms should anticipate departure during good times, when a sponsor seeks to cash out its investment, and during bad times, such as when sponsor disagreement may risk crippling the venture's activities. If sponsors are also engaging in ancillary contractual arrangements with the venture company, contingencies should be contemplated to permit exit rights if most of the foreign investor's benefit is captured in the ancillary agreements, and those agreements are, for whatever reason, not executed.

The common exit strategies include: an initial public offering of shares in the venture; put or call option agreements among the investors in the consortium that could be used to resolve disputes or to take advantage of a relaxation in local control regulations; and the invitation of other strategic investors to participate in the venture, to add either financial or technical capabilities. A critical issue associated with the negotiation of exit strategies is control. Parties should determine beforehand when and subject to what terms changes in shareholding can occur. In addition, the effects of any change in shareholding on the control structure of the venture must be considered. Parties should specify whether entrants will be issued new shares, diluting the control of current shareholders, or whether current shareholders will divest their holdings (and, if so, how). Finally, the parties should agree beforehand on a valuation method: examples range from the book value of the shares to a predetermined price that compensates an investor for its initial investment plus an agreed upon return. The sponsors should keep any legally imposed transfer restrictions in mind while negotiating the terms of each party's exit from the venture.

5.0 SUMMARY

The deregulation trend that is sweeping the developing world provides significant opportunities to gain access to previously inaccessible markets, and the telecommunications field is no exception. The undertaking does involve significant risk, some endemic to all cross-border investments and some unique to the telecommunications field. As a result, any prudent party contemplating an investment in a cross-border telecommunications venture must carefully study the risks associated with the country in which investment is contemplated and the other parties with which such investment will be made. The results of this due diligence review must be incorporated into a party's negotiating goals and strategy. Once the proper background research has been completed, the prospective participant should negotiate and assess all the structural elements of the venture as a whole, to account for (and capitalize on) the interdependence of each component of the transaction. Taking these steps will not guarantee a successful venture, but it can help to minimize the additional risks associated with telecom investments transactions that, by their very nature, often require significant amounts of capital.

"Convergence" is Needed in the Workplace;

Its Lack May Cause Serious Miscommunications

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Yu Serizawa, President of Forma Corporation, Tokyo

This paper discusses the behavioral side of "convergence," particularly as it may occur in offices. In step with the so-called globalization of business and as an analog of the convergence taking place in electronic equipment, businessmen expect that business practices, taxation systems, etc., in different countries will also converge. In fact, any such convergence is a far from a natural process, and there are considerable differences between business in different countries. Business procedures, though superficially similar, may differ considerably in practice. If you assume that business practices are converging on a common international standard, you lay yourself open to serious miscommunications. It is easy to list numerous national differences in a manual for cross-border businesses. But a manual of this kind— bulky and necessarily non-systematic— will be of little use in the real world of business, not least because of the unpredictability and urgency of the emergencies that might call for its use and the difficulty of finding the right answers in time to be useful. The authors have therefore launched an original training program in the belief that the best crisis management policy for a company investing overseas is to make its expatriates aware of cultural differences and functional in overcoming them. The best approach will be to adopt the mental flexibility to identify and dispense with unconscious preconceptions in business. The way of doing things is necessarily different in different cultural contexts. The authors share some tips for modifying our ways of thinking so as to usher in true "convergence."

The authors are experienced in setting up international business alliances and now run a cross-cultural training course for Japanese business persons posted overseas, which is equally applicable to non-Japanese business persons stationed in Japan.

Introduction

The primary reference of the phrase "coping with convergence" is to the technological side of equipment for telecommunications, computing and consumer electronics. Consider the example of the video screen. It is now technically possible to use a single screen for computing, information retrieval and TV entertainment. At home, however, at least two kinds of screen are generally needed. One will be a big screen primarily for entertainment, with a viewing distance of six feet or more, that may also be used to display information. The other will be a smaller screen, primarily for information display with a viewing distance of two feet or so, which may also be used to show TV programs. This shows that a technological development may not necessarily, and certainly not immediately, be paralleled in human behavior.

Both "globalization" and "business ethics" are buzzwords in every part of the world. Businessmen and -women, dispatched overseas with no training in the cultural differences likely to be encountered, and none in how to attain convergence in the workplace, will naturally tend to assume that their usual ways of conducting business will work: the new workplace is, after all, a subsidiary of head office, from which they come, and usually has the same management structure. They will therefore behave much as they would in their home workplace. This unconscious assumption of "business as usual" is a fruitful cause of miscommunication. Their messages may not be received by local staff as intended. A steady stream of miscommunications can cause resentment among employees. In a worst-case scenario, the executives will be accused of discrimination or harassment.

An examination of the situation reveals that the expatriates regard their way of doing things as the international standard, even though it may be more distinctive of Osaka or San Jose. By no stretch of the imagination can it be called a common international standard.

Nevertheless, the relentless pressure of technological convergence and the globalization of business force businessmen and -women to cope with cross-border communications and multicultural management.

Case studies

An Englishman who worked in London for the subsidiary of a Japanese company complained that the hardest thing for him was to grasp his Japanese boss's non-verbal messages. To the other Japanese staff dispatched from Tokyo, it was easy and quite natural to get the right message from those non-verbal communications. In contrast, the Japanese staff were slow to catch the symptoms of distress, discomfort or even mistreatment shown by their local employees.

The same Englishman complained that the Japanese boss always "ordered" him around, seldom just asking him to do something. Was the Japanese boss being arrogant? Was his management style too autocratic? Not necessarily. It might well be that the Japanese boss's poor command of English made him unnecessarily curt in his communications. But a more important factor is an underlying assumption made by most Japanese. The average Japanese associates more polite or formal expressions with "politeness language," which is such an integral part of the Japanese language, and which is used towards seniors. The unconscious assumption is that polite expressions are only for superiors, not for subordinates. The plainer, more direct forms are thought to be much friendlier and informal. A wife might feel her husband cold and unloving if he consistently used the polite forms to her. This is why the Japanese boss will use imperative expressions without adding the word, "please," for instance. But this by no means justifies the boss's treatment of the English employee. But rather than accuse him of arrogance, we should see that his misconceptions are removed, and that he becomes aware of the differences between English and Japanese usage in the workplace, and the misunderstandings they are likely to cause.

Perhaps you remember the sad case of Mr. Di Muro, an American baseball umpire who worked in Japan last year. He left Japan after only three months, because he felt in danger when surrounded and shoved by several players and coaches protesting his call of "strike." Under the headline "Slugger swings, fans cheer, ump walks," the Washington Post reported that manhandling of umpires— absolutely taboo in the United States— is quite common in Japan, although Japan is one of the world's least violent societies. Fans threw plastic noise-makers and garbage into the field to protest the umpire's call. Mr. Di Muro said, "What will the next guy be allowed to do if I call a strike— take a bat to my head?" This incident tells us two things. First, that Japanese professional baseball has diverged from the American game since it was originally introduced from America. Second, the umpire is strong in America and weak in Japan, although the number of players and umpires is the same in both countries. This incident also forces us to recognize cultural differences in the expectations of the public with respect to umpires, coaches and players.

The case is also a reminder of Japanese group behavior. The Japanese see democracy as a system in which everyone is free to have their say regardless of time, place or occasion. You have doubtless noticed in business meetings with Japanese that the boss will bring along several subordinates or colleagues to meet you, and that they will often speak without bothering to get permission from the boss sitting beside them.

About a year ago, an interesting report was published by the National Bureau of Asian Research (NBR) entitled "A Looming Entry Barrier: Japan's Production Network in Asia." Its basic theme was as follows;

"...Japan has adopted a regional industrial policy throughout Asia, similar to the industrial policy that guided Japan's economy in the post-World War II era, and with the same kind of exclusionary effects that have made the market in Japan so difficult for foreign companies to penetrate."

"...Japanese production networks represent an Asia-wide threat to free and open trade...(and this) holds a danger for the host economies which become 'captive' to network strategies that strictly control diffusion of technology, impose harsh contract terms and limit the promotion of local managers."

In the eighties, it is true that Japanese executives were concerned over cheap imports from developing economies to which Japanese companies had transferred their technologies. In those days, the Japanese market was virtually closed to foreign companies especially to those from advanced economies. Now, things have changed dramatically. Many governmental regulations have been lifted, and Japanese companies have to compete with foreign companies not only overseas but also in the domestic Japanese market. This has changed Japanese executives' attitudes. They are far more concerned with the interests of their own companies than of Japanese industry in general. They are now eager to enter strategic alliances with their competitors overseas. They try to globalize their companies and to modify their way of doing things with a much higher priority on ethical issues than before. There is no room at all for coordinating their business strategies with those of their Japanese competitors. However, their attitudes and behavior are still perceived as if they are still doing the same kinds of thing they were doing more than a decade ago. The reason is a distinctive Japanese "quirk" as marked as the one behind the baseball case. The executives still talk of "the industry" and "Japan's interests" when they mean their own company and its own interests. They pay lip service, if you like, to the concept of Japan Incorporated. When Japanese bureaucrats speak, they tend to use "we" or "the Japanese" instead of "I." Japanese bureaucrats cited the peculiar needs of "Japanese culture and tradition" when requesting that the 1990's ivory trade ban be lifted last year and in opposing the opening up the Japanese rice market a couple of years ago. This is asking for the kind of misunderstanding we see in the NBR article.

Preconceptions are the culprits

Mistaken preconceptions leads to misunderstanding, the basis for miscommunications. We need to examine the assumptions on which such preconceptions are based. When you meet someone with the title "General Manager, Telecommunications Division," you may assume that he has authority to commit the company to his decisions in the telecommunications business. After all, doesn't his business title tell you that? Not, perhaps, if he is from a Japanese company! More often your assumption will be far from the truth. When a decision is required, he may have to consult the general manager of the Communications Equipment Plant, or he may have to circulate a proposal or briefing (in Japanese a "Nemawashi") to obtain the reaction of his superior, who may be the Managing Director supervising telecommunications businesses, before a decision can be reached. You will be safer *not* to believe English-language business titles on Japanese business cards.

A board director in Japan is a rather different being from his or her counterpart in other nations. Although the board of directors is legally invested with the highest decision-making authority, directors are in fact subordinate to the President or CEO. All the executive vice presidents and other directors, a total of as many as thirty or forty people, are in effect corporate executives reporting to the president. The chairman will not be the chairman of the board in the same sense as it is known outside Japan, but a nominally senior position to which retired presidents are "promoted upstairs."

In a German company the directors board is virtually an executive board, but it has a separate auditors board, which functions more like the board of directors in Anglo-Saxon society. In a Japanese company, too, you will find standing auditors, who are approved at the annual general meeting of shareholders. However, the candidates are selected from among the employees or directors by the president, and they themselves maintain an "insider" mentality that largely prevents them from adequately representing the stakeholders' interests.

Executives' titles differ also from one country to another. As you will know, the term "managing director" in Britain means CEO. In France, the "Monsieur le President" is better understood as the chairman.

"Corporate governance" is also becoming a major concern in Tokyo. Suppose that an American lawyer were to hold a seminar on this issue in Tokyo. She calls for "directors" in Japanese companies to be more informed and more actively involved in the administration of their companies. The reaction of the audience would be cool, to say the least. Because "directors" are actually "executive officers" and as the heads of business units they will necessarily be well aware of critical information, and carry day-to-day responsibility for administrating their own business units. If the lawyer enthusiastically tries to persuade the audience without taking into account the actual practice in Japan, she cannot achieve effective communications with the "directors," who will feel they have nothing to learn from her.

"What do you take for granted?"

The ideal may be to have identical business systems and practices in different countries. Even so, this alone is not enough to guarantee freedom from miscommunications. There are so many languages and linguistic nuances. The meaning, or *range* of meanings— the connotations— of the nearest single-word equivalent may differ widely in different languages. Even within the same language your message will not always be understood as you intend. No message can have the clarity of a mathematical formula. The meaning conveyed will differ according to the background of the recipient, the emotional atmosphere, and the body language of the speaker. Against a different cultural background, the gap between the message as sent and as received will yawn wider. If you stick to your own logic, it will be hard for the recipient to get the message you intend to send. Good communicators do not keep to their own logic, but restructure the message in line with the recipients' logic. In a meeting, if I stick to my agenda, and if you stick to yours, it will be difficult to have a real meeting of minds. Perhaps the most productive procedure would be to seek agreement first on "our" agenda, a synthesis of the two agendas. This is an idea advanced at the PTC a few years ago by Ron and Joan Parsons of The Alliance Collaborative, based in Portsmouth.

The first step to composing "our" agenda is not to abandon the conviction that "my way is best" but to admit that there must also be acceptable alternatives. Please always try to keep an open mind to accept such alternatives. The second step is to pay close attention to anything and everything that does not accord precisely with your expectations. Observation and listening can be a great help here. The atmosphere of the meeting room, the body language or the attitudes of the participants, the reactions of the people, and anything that seems strange or unusual to you will be an excellent opportunity for learning the differences or variations from your own culture. One difficulty to be overcome here is that the stronger your preconceptions, the more you will tend to overlook these signs. Whenever you notice such signs, ask your local colleagues or friends to tell you what they mean. Some may indeed be exactly as you thought, but others will almost certainly be quite different. The greater the difference, the more valuable the learning experience.

The third step is the hardest thing of all. It is to ask yourself what it is you take for granted. This will help you to estimate the distance between your ways and the local ways. Knowing this distance is very important to prevent miscommunications.

The convergence of different business practices towards an internationally accepted standard is desirable from the viewpoint of the business world. However, we also have to make sure that such "convergence" is not a pretext for cultural imperialism. The reality, however, is lagging so far behind expectations that there is little danger of this in the near future, although trends toward convergence can be detected. The question, then, is what kind of convergence are we to seek.

Conclusion

The convergence of telecommunication, computing and consumer electronic equipment is taking place at a bewildering pace. This was made possible by the development of technologies. This convergence has brought world markets much closer to the domestic market. The psychological distance to a foreign market has shrunk virtually to zero, thanks to those technologies. In line with this technological convergence, we must work towards another kind of convergence, one that will bring the business practices of different countries towards internationally accepted standards but which should, again, be sought with all due care to order to avoid recent French criticism. This claimed that "globalization" as used now means a *de facto* "global americanization," or a "global adoption of American standards." But whatever form of convergence we seek, we must realize that it will be some time before its necessity is universally recognized and even longer before it can be established.

Our short-term conclusion is that internationally active businessmen and -women should to be alert for the differences in local business practices, and to aim for convergence between the different practices and cultures through frequent and careful verbal explanations and communication. As a long-term objective, we must all get together to define the values inherent to an international business standard, and to determine the appropriate means of communication for implementing these values in the multicultural workplace.

ATM-Based Telemedicine Trial in Taiwan

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1. ABSTRACT

To be a communication backbone of National Information Infrastructure, a nationwide broadband ATM network has been deployed by Chunghwa Telecom Co. to provide broadband services in Taiwan. Telemedicine has been one the major applications to improve the medical quality and to enable experienced experts to help the doctors at rural or remote sites diagnose patients. Three pairs of hospitals have been using the telemedicine services. Based on the success of the trial, the telemedicine services will be expanded to an island-wide scale and is expected to bring medical standard in Taiwan to a new era.

2. INTRODUCTION

Broadband Integrated Services Digital Network (BISDN) has become the trend of future telecommunications network due to its flexibility to provide different services in a network and its efficiency to utilize the telecommunications facilities. Besides data communication, BISDN can also provide TV program distribution, video conferencing, and entertainment services. Information of broadband services is transported in fixed sized cells and routed through an Asynchronous Transfer Mode (ATM) network.

Providing high-speed telecommunication networks will be helpful for Taiwan to attain the aspiration to be the Asia-Pacific Regional Operations Center. Chunghwa Telecom Co. (CHT), therefore, has actively deployed a nationwide ATM trial network that can act as the communication backbone of NII, and some ATM local area networks in the Greater Science-Based Industrial Park (GSBIP), Northern Taiwan Business Group of CHT, Kaoshiung Harbor, Taichung Harbor, Keelung Harbor, and Hwa-Lien Harbor. Many broadband services including LAN interconnection, video conference, distance learning, telemedicine, image transfer, and multimedia database retrieval have been provided on the network.

Based on the technology of telecommunications, it is possible to improve the medical quality in rural and offshore districts. Department of Health and CHT have devoted much effort on telemedicine using DS1 circuit emulation interfaces provided by the ATM trial network. The trial will enable experienced experts at the equipment-advanced hospitals to help doctors at rural or remote hospitals using medical video conferencing, medical history and image transmission, electronic bulletin board capabilities, etc.

In this paper, we describe the deployed ATM-based broadband network, especially on broadband network and telemedicine. The cause of failure is analyzed to improve the network reliability and to satisfy the demand of service continuity. The importance of telemedicine system is also described to minimize the medical resource gap between urban and rural areas.

The rest of this paper is organized as follows. Section 3 introduces the ATM trial network. The telemedicine network is described in Section 4. Section 5 evaluates the efficiency of the trial results. Finally, conclusions are drawn in Section 6.

3. ATM TRIAL NETWORK

To satisfy the increasing demand in network bandwidth and to provide versatile services, Chunghwa Telecom Labs (TL) has been developing ATM-based broadband products. Several products, including ATM switches (BEX-VPX), ATM multiplexers (BEX-AMX), ATM LAN switches, and ATM hubs, have been completed. Based on BEX-VPXs and BEX-AMXs, CHT has deployed a nationwide ATM network which has contained ten sets of BEX-VPXs by June 1996 [1]. To increase the reliability and trunk capacities, connection between two BEX-VPXs uses both an OC-3c trunk and a DS3/PLCP trunk. The architecture of the nationwide ATM trial network is shown in Figure 1.

3.1 ELEMENTS OF ATM TRIAL NETWORK

An ATM trial network contains three parts which are BEX-VPX, BEX-AMX, and network management system (NMS). They are described as follows.

(1) BEX-VPX:

A BEX-VPX system consists of eight racks and each rack has four modules. Each rack can be configured as either a user network interface (UNI) or a network node interface (NNI). Among the thirty two modules, each module can be either an OC-3c module (one port per module) or a DS3/PLCP module (three ports per module). The system capacity of a BEX-VPX is about 5 Gbps. To increase system performance, the switching fabric of BEX-VPXs adopts shared buffer memory architecture. BEX-VPXs provide PVC cell relay services which are managed by NMS.

(2) BEX-AMX:

A BEX-AMX connects to a BEX-VPX by a UNI interface operating at either an OC-3c or a DS3/PLCP. Each BEX-AMX consists of three types of user interfaces: DS1, DS3 and Ethernet. Moreover, the BEX-AMX mainly provides the user access interfaces and performs the electronic-optical signal conversion. With respect to the provided services, DS1 circuit emulation, DS3 circuit emulation, and Ethernet bridging function are offered by combining the BEX-VPX with BEX-AMX. DS1 and DS3 circuit emulations can provide real-time applications which require constant bit rate transmission. Ethernet bridging function can provide transparent LAN interconnection service over the ATM network and can let users form virtual LAN networks.

(3) NMS:

NMS is connected to the network through an NNI with operation interface using AAL5/ATM protocol. It provides functions on configuration management, fault management, performance management, and security management. These functions are summarized below.

(a) Configuration Management:

- Configuration of network nodes: Any BEX-VPX, BEX-AMX, Optical Amplifier, and trunk can be added to, modified, or deleted from the network.
- Management of Permanent Virtual Circuit (PVC): The management of PVC includes functions of establishment, modification, deletion, display, and report.
- Rerouting of PVC: Existing PVC can be rerouted automatically or manually if there is disruption of connection.

(b) Fault Management:

The fault management includes functions of receiving the notification from BEX-VPXs, BEX-AMXs, and Optical Amplifiers with appropriately response if necessary, executing segment-to-segment audit between any two BEX-VPXs, executing end-to-end audit between any two BEX-AMXs, displaying and logging system messages.

(c) Performance Management:

The performance management contains functions of collecting traffic and performance information, setting thresholds, and generating related alarms.

(d) Security Management:

Two level access controls for operators and administrators are provided.

A network function monitoring procedure is used to monitor the status of the network. This procedure can be executed either automatically or on demand. Once a fault is identified, a network fault handling procedure is executed to minimize influence to on-line users.

3.2 Applications of ATM Trial Network

Based on the ATM trial network provided services of DS1 circuit emulation, DS3 circuit emulation, and LAN bridging functions, several pilot projects and demonstrations running over this ATM network are in progress. Among these services, telemedicine project will be discussed in Section 4 in detail. Other projects including multipoint video conference, campus networking, distance learning, and international ATM interconnection are briefly described as follows.

(1) Multipoint Video Conferencing Project:
CHT has set up a DS1-based video conferencing system to connect its eight district subordinate organizations, including IBG, NTBG, CTBG, STBG, LDMBG, TL, TTI, and DCBG. Within this system, a multipoint control unit (MCU) located at TL is the operation center and decides which screen at a specific site should be broadcasted. Through this video conferencing system, the employees of CHT can hold a meeting without the limitation of distance and can save lots of time and transportation cost.

(2) Campus Networking Project:
To share the education resources among schools, Ministry of Education (MOE) and CHT have been conducting a campus networking trial. This trial interconnects the campus networks of seven universities, including Taiwan University, Central University, Tsing-Hua University, Chiao-Tung University, Cheng-Kung University, Chung-Cheng University, and Sun Yat-Sen University. The campus ATM networks of these universities are all connected to BEX-VPXs through DS3/PLCP interfaces.

(3) Distance Learning Project:
To enhance campus teaching and learning and to alleviate the difference of the education resources among universities, NII steering committee and MOE have been prompting a distance learning project. Three universities, including Taiwan University, Tsing-Hua University, and Chiao-Tung University, have joined this project. Students in these universities can register and take the courses offered by other universities. These sites interconnect each other through a DS3 transmission rate of ATM/ADM (add-drop multiplexer) path and use the Digital Cross Connect system to perform the broadcast function for multisite teaching. In the future, universities from Hong Kong, Singapore, and USA will also join the program.

(4) International ATM Interconnection Project:
To verify the standard conformance for the developed ATM switches and to enlarge the ATM field trial scale, CHT has launched international ATM trials with Hong Kong Telecom, Singapore Telecom, and U.S. Sprint. The international trials use DS3 transmission rate to interconnect the BEX-VPX ATM switches located in CHT and switches of Fore and NewBridge located in labs of the foreign carriers. Applications which have been tested are video conference, video on demand, and LAN interconnection.

4. Telemedicine Network

The highly integrated application system of telemedicine is combined with medical skill and telecommunication technology. There are two critical factors to achieve this application system. One is the telecommunication backbone provided by CHT. The other is the image management and communication capabilities which provide medical physicians and out-patient department instant access.

4.1 Architecture of Telemedicine

To fit the high speed transmission demand of image and data access, Department of Health (DOH) and CHT have conducted a DOH-supported telemedicine project on the ATM trial network using DS1 circuit emulation interface. Three pairs of hospitals have been using the telemedicine services. They are National Taiwan University Hospital to Jin-Shan Health Center, National Cheng-Kung University Hospital to Provincial Peng-Hu Hospital, and Taipei Veterans General Hospital to Kin-Men Granite Hospital. The architecture of the telemedicine network is shown in Figure 2.

4.2 Applications

The success of image management and communication capabilities has promoted the development of telemedicine. As an example, Figure 3 shows the application architecture of National Taiwan University Hospital to Jin-Shan Health Center. A scenario of the application is explained as follows:

(1) Medical video conferencing:

- Health workers in remote area or off-island can participate in many activities, including case study, medical conference, etc.

- To provide training courses to health workers in remote area or off-island
- To support large medical meetings

(2) Medical history and image transmission

- Instant access to image libraries containing digital X-ray, CAT scan images, EKG, Ultrasound
- Instant retrieval of patient medical information

(3) Electronic bulletin board capabilities

(4) Distance joint diagnosis

- To provide real-time consultation and treatment of emergency patients

5. Field Trial Results

The trial system has been started in April 1996. After the first trying period for one and a half years, we have noticed that service continuity is extremely important and has big influence on joint diagnosis. In order to guarantee this, we not only recorded each failure in detail including time of interruption, description of phenomenon, the way to resolve, and the strategy of failure preventing, but also analyzed the availability of the system [2]. To reduce the interruption time, system maintainers must resolve each problem as soon as possible. From the collected data, there are many topics worth to evaluate. One can calculate the availability of telemedicine during the trial period. An availability of 98.95% [3] has been achieved during the trial period. The other focuses on the analysis of the failure. The analysis can be used to identify the cause of failure and to improve the system reliability through analysis. Several critical factors that affect service continuity have been summarized as follows:

(1) ATM Trial Network

- Malfunction of CSU/DSU equipment
- Failure of transmission unit
- Malfunction of BEX-VPX)
- Malfunction of BEX-AMX
- Malfunction of NMS
- Broken of optical fiber due to digging

(2) CPE Equipment

- Failure of power supply or outage of power
- Speed of CPE cannot achieve T1 rate
- Malfunction of CPE
- Bugs caused by application software
- Operating error caused by unfamiliar operators

6. Conclusions

In this paper, we have described the ATM-Based telemedicine trial in Taiwan. During this trial, critical factors that may interrupt service continuity have been identified and improved. Contribution of the trial network is summarized as follows:

(1) ATM trial network

- Analysis of failure was used to improve the system reliability
- Bugs were pointed out to correct function
- Adding new function to meet requirement
- Reducing the effect of manpower and environment

(2) Telemedicine

- Minimizing the medical resource gap between urban and rural areas.
- Providing real-time consultation and treatment of emergency patients
- Providing training ranging from basic health worker skills to advanced specialist techniques
- Increasing overall operating and inter-hospital cooperative efficiency
- Constructing inter-hospital medical techniques and supporting mode

Owing to success of the ATM-Based telemedicine trial, the government has promised to expand the telemedicine scope in the future. The scope will become more widespread as island's public and private sectors continue to cooperate. Certainly, the ATM network will play a critical role on the transformation of medical environment.

7. References

[1] C. C. Lin, et al., *Deployment of ATM Broadband Network Trial and Service*, Chunghwa Telecom Labs, June 1996.

[2] Bellcore, SR-TSY-001171, *Methods and Procedures for System Reliability Analysis*, Issue 1, Jan. 1989.

[3] S. S. Liu et al., "A Broadband Trial Network and Availability Analysis", *IEEE SICON'97*, Singapore, April 1997, pp. 141-154.

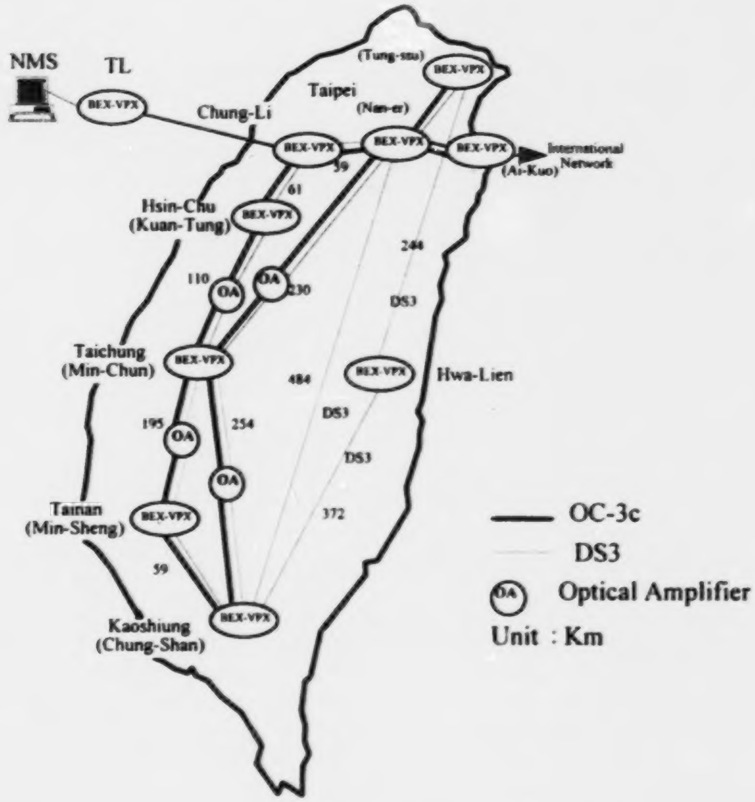
NMS
TL
BEX-VPX
Chung-Li
Taipei
(Tung-ssu)
(Nan-er)
(Ai-Kuo)
International Network
59
61
Hsin-Chu
(Kuan-Tung)
110
OA
230
244
DS3
Taichung
(Min-Chun)
484
Hwa-Lien
195
254
DS3
DS3
372
Tainan
(Min-Sheng)
59
Kaoshiung
(Chung-Shan)
OC-3c
DS3
Optical Amplifier
Unit : Km

Figure 1. Architecture of the Nationwide ATM Network

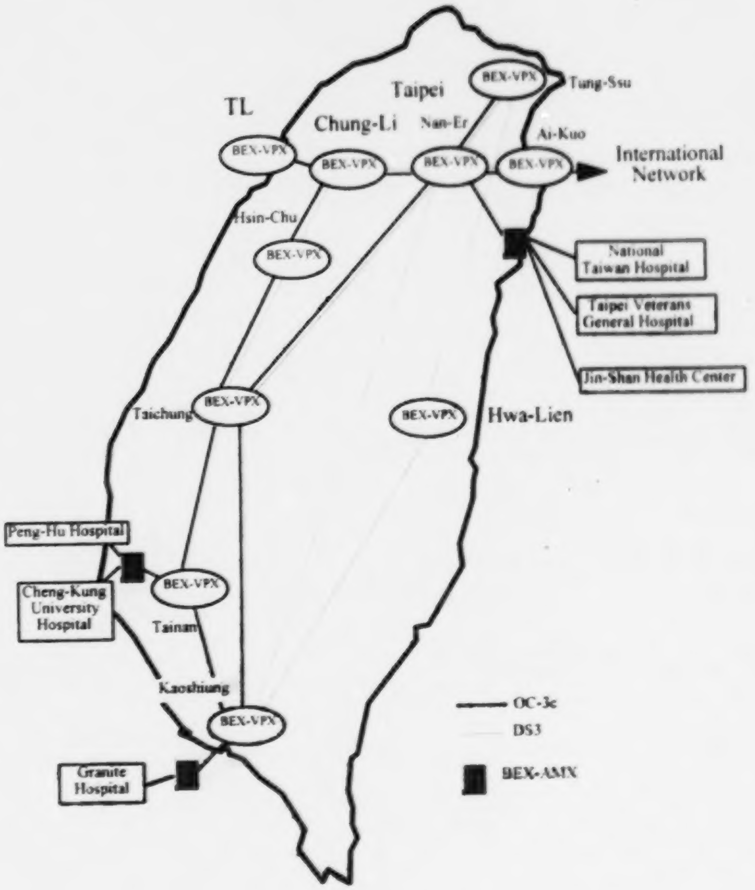
TL
Chung-Li
Taipei
Nan-Er
BEX-VPX
Tung-Ssu
Ai-Kuo
International Network
Hsin-Chu
National Taiwan Hospital
Taipei Veterans General Hospital
Jin-Shan Health Center
Taichung
Hwa-Lien
Peng-Hu Hospital
Cheng-Kung University Hospital
Tainan
Kaoshiung
Granite Hospital
OC-3c
DS3
BEX-AMX

Figure 2. Architecture of Telemedicine Network

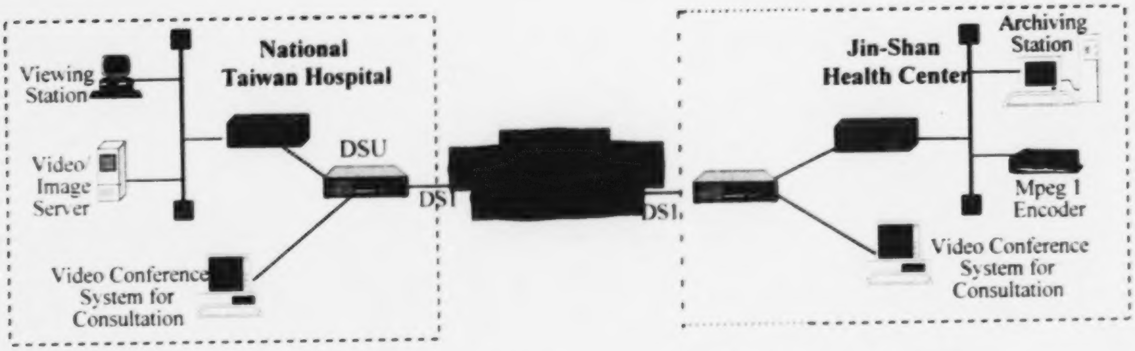
National Taiwan Hospital
Viewing Station
Video Image Server
DSU
DS1
Video Conference System for Consultation
Jin-Shan Health Center
Archiving Station
Mpeg 1 Encoder
DS1
Video Conference System for Consultation

Figure 3. Telemedicine between Taiwan University Hospital and Jin-Shan Health Center

From Radio Relay Links to Telemedicine
-Proposing "The Telecom Aid Activity "-

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1. ABSTRACT

Our NGO, Basic Association is very small but what we have accomplished in the past five years ranges from implementing Radio Relay links to transfer image and data in the damaged areas around Chernobyl to providing Telemedicine or internal PBX Telecommunication system inside the hospitals for mutual communication. Our activities will expand further from now on.

2. TELECOM & BHN (BASIC HUMAN NEEDS) & CIVIL-MINIMUM

Basic human needs such as food, clothing and shelter, elementary education, medical treatment are essential for human beings to live and lead a life. Also life line such as water supply, electric power, means of communication and means of transportation is necessary for human beings to maintain the minimum civilized life. Among them communication, especially telecommunication above all, is overwhelmingly powerful and we can say that it is the best civilization means of civil minimum from the viewpoint that it spreads and increases human sense ability such as hearing and sight to the extreme limit as well as it conveys voice, image and document etc. to deliver our will at real time. However, it is only a limited number of nationals and local residents among all mankind on the earth that benefit this civilized means. This fact was pointed by ITU Independence Committee Report "Mussing Link" in 1982 and after that much efforts have been made to improve the situation, but it is true that it has not still been in sufficient situation even now in a large amount of areas. We sometimes come across the case that even if the basic facility has been implemented they can not mature its advantage because of lack of investment for the second version up or shortage of daily repair and maintenance.
The advantage that highly developed information conveying ability of telecommunication has brought to mankind is extremely big. But ordinary users may feel the existence of telecommunication is natural just as air and few people think what may happen if telephones disappear from this world.

But those who have been involved in telecommunication business, especially in network management business and have experienced of being cultivated in this area, feel deeply how important they are in the network society and feel cowered to think what a big social disorder there happens and how much blame the public accuse of its network management if some disaster or accidents occur. It seems the outer people don't take it so seriously than we expect.

However, how do you evaluate the degree of the civilization of your life if you live in the society where the network originally doesn't exist at all or it exists but doesn't function sufficiently?

Actually there are numberless of those areas and occupations in the world. In order to improve the civilization standard of the whole human living, we should make up for the insufficient situation of telecommunication and give relief to them. It may be the people who have worked hard and went through difficulties in the telecommunication carriers regardless of nationalities and departments that understand the necessity of it most.

It has been discovered since old times that the spread of telecommunication is correlated with the nation's economic power. Look at Figure 1, which is a bit old data and we can find out that there is a remarkable correlation between GDP per person and the spread rate of telephones. It is important that huge programs should be made and much investment can be done in order to construct the network sufficiently, maintain them and level up them. We cannot realize them without superintendent government offices and carriers with high technology and economic power. But even if such organizations exist, there are not a few cases where the actual conditions of service level are extremely poor on the sites.

Basic Association is aiming to discover such cases in the developing countries and market developing countries (ex-socialist countries), to substitute them and to offer projects to supplement them.

For example, (1) the case where there are hospitals, capable doctors and nurses on the medical site, there are however no means of communication between wards or there are means of communication but they are decrepit and useless so that it takes time to gather the necessary doctors for an emergency case and offers only inefficient medical treatment.

(2) the case where the patients living in no medical facilities areas far from the urban medical organizations, are left alone just as the damaged area of Chernobyl nuclear accident. On the site, they wish to offer at least traveling medical check-ups, but they voice there are no means of transferring medical data from remote sites to cities for quick advice.

(3) the case where there lies anxiety to dispatch doctors and volunteers urgently to the areas where natural disasters such as earthquakes, eruptions and forest fires often happen because there are usually not enough means of communications in those areas.

We have already experienced coping with all of these cases so far. We call these projects "Telemedicine" or "Teleenvironment".

I would like to state the actual examples in which we have been engaged so far.

3. TELECOM FOR BHN

3.1 RADIO-RELAY-LINKS FOR VICTIMS OF CHERNOBYL NUCLEAR ACCIDENT

The worst nuclear accident in the world's history took place on 26 April 1986 in Chernobyl nuclear power station in Ukraine. It was the catastrophe which caused 10 millions sufferers and exposed nearly one million people to ionizing radiation. The damaged area extends over three countries Belarus, Ukraine and Russia. In spite of desperate measures made by each country, they are still in the serious condition that there remain radioactive nuclides in some areas and the number of thyroid cancer among children is increasing recently in the affected areas. (See Figure 2) In 1991 WHO (World Health Organization)

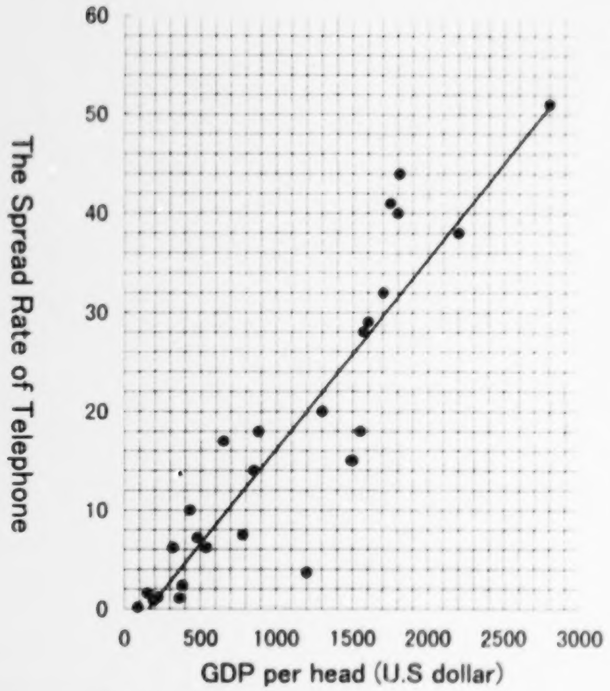


Figure1

Reserched data by CCITT,Economic Studies at the National Level in the Field of Telecommunications (Geneva;ITU 1968)

Figure2

The number of thyroid cancer among children (0-14 year-old at that time) by country after Chernobyl nuclear accident

	Pelarus	Russia	Ukrine	Total
86	2	-	8	10
87	4	1	8	13
88	5	-	11	16
89	7	1	23	31
90	29	8	40	77
91	59	8	42	109
92	66	8	75	149
93	79	12	75	166
94	82	33	80	195
95	91	33	*	124*
Total	424	104	362*	890*

*Data Is not decided.

Medical Radiological Reserch Center in Russia
March, 1996

has implemented IPHECA (International Programme on the Health Effect of the Chernobyl Accident) project and has decided to accumulate and make use of victims' annual check-up data (including image data taken by echo system) for data base stored at MRRC (Medical Radiological Research Center) located in Obninsk (100 km south of Moscow) in Russia. There were not however lines in local areas which can transfer such images to the center. Therefore WHO referred to the world for an installation of such lines. Then Basic Association, as Japanese NGO offered one idea to them. That is to make reuse of the equipment currently used for analog lines provided by NTT (Nippon Telephone & Telegraph Co.) since NTT had been promoting network digitalization in those days. This idea was welcome to WHO and MRRC. Russian sides executed the implementation under the guidance of NTT engineers and they were completed in October 1994 and have been used since then. At general meeting of International Pathology Academic held in Hong Kong coincidentally at that time, pathological images were transmitted from Obninsk as the example of Telepathology and they received high evaluation. WHO bore the actual implementation expenses.

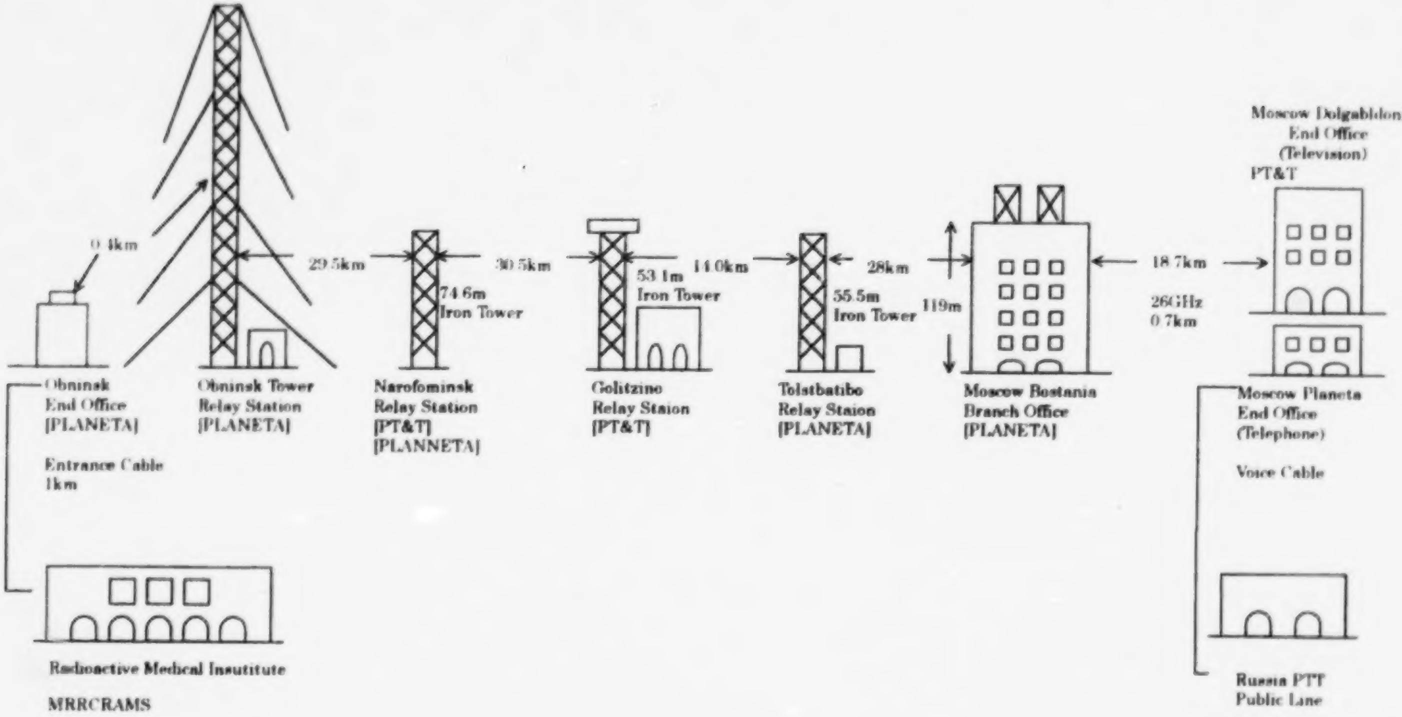
It was really a heavy burden for Basic Association with only a few members at that time to implement the microwave lines of more than 100 km with six relay stations. (See Figure 3) Fortunately we could make it with strong back up of two international organizations of WHO and ITU, well-understanding of Russian Telecommunication Ministry and much support of Japanese Ministry of Posts & Telecommunications, Ministry of Foreign Affairs and NTT.
Our heart is full of deep emotion that small NGO like ours could accomplish such a big project.
I would like to comment on this later.

3.2 TELEMEDICINE SYSTEM FOR REMOTE TRAVELING MEDICAL CONSULTATIONS

We began to tackle the next field by visiting the damaged areas in Ukraine suffering from the Chernobyl accident. (See Photograph "Children at Korostn inter-area medical diagnostic center") We provided not only Telemedicine activities but also support of medical activities by accompanying doctors directly and by bringing medical materials and medicines themselves to the site. We owed these activities to aid from "International volunteer savings funds" promoted by Japanese Ministry of Posts and Telecommunications.

In relation to the Chernobyl accident a lot of assistance have been made since early times for the victims' medical check-ups and treatments by many countries including Japan, but recently a part of those assistance have been suspended. There are some areas where radioactivity still remains and regular medical check-ups are essential in those areas. We thought of traveling check-ups system in which portable multi-media terminals, developed inside Japan, for satellite communication are used. We found out that the system would be of great help for multiple remote medical consultations by introducing it to communications between local medical centers and mobile medical buses. We have begun to provide the system in four areas, Kiev, Zhitomir, Rovno and Boris. Much expectations are gathered in local areas since this system can be carried out in fairly low cost (approximately 20 thousands dollars per set) and are possessed of a lot of functions. However, the organization should be prepared for the system since expertise is needed in assembling machines and tools and maintaining them. The Telemedicine system in Ukraine was contributed by Ministry of Posts &

Figure 3


0.4km
29.5km
30.5km
14.0km
28km
18.7km
74.6m
Iron Tower
53.1m
Iron Tower
55.5m
Iron Tower
119m
26GHz
0.7km
Obninsk
End Office
[PLANETA]
Entrance Cable
1km
Obninsk Tower
Relay Station
[PLANETA]
Narofominsk
Relay Station
[PT&T]
[PLANNETA]
Golitzino
Relay Staion
[PT&T]
Tolstbatibo
Relay Staion
[PLANETA]
Moscow Bostania
Branch Office
[PLANETA]
Moscow Dolgabldoni
End Office
(Television)
PT&T
Moscow Planeta
End Office
(Telephone)
Voice Cable
Radioactive Medical Insutitute
MRRCRAMS
Russia PTT
Public Line

Outline of Microwave Route between Moscow and Obninsk 1995, Spring

Telecommunications in Japan.

3.3 PROVIDING HANDY TELECOM SYSTEM FOR COMMUNICATION INSIDE HOSPITALS

What we have discovered next was the fact that there exist approximate number of hospitals and adequate doctors in urban cities, but PBX Telecom system inside a hospital have become decrepit or the amount of system has been completely insufficient. The wards of these hospitals are dispersed in the fairly wide compound and the means of mutual communication among management ward, check-ups ward, operating room and warehouse of materials have been definitely underequipped. They walk or use bicycles for mutual communication, which decreases medical efficiency notably.

We have decided to provide PBX-based mobile personal handy-phone system (contributed by NTT Mobile Communications Network Inc. or NTT DoCoMo in Japan) to those hospitals.

The first system was implemented in the Central Emergency Hospital in Kiev and the system was welcome to doctors and nurses working at the center very much. The cost of this system is also fairly low and it is easy to implement them, so we expect they will be the most suitable system for those hospitals in which they are Troubled with internal PBX Telecom system. At the ceremony of the presentation of this system held in October 1997, Ministry of Health and Ministry of Telecommunications in Ukraine as well as Dr.Tarjanne, Secretary-General of ITU attended and he praised highly the system as symbol of Telemedicine in his speech :

To complement this effort(Large-scale programs of medical surveillance for the Chernobyl accident), two telemedicine pilot projects were launched in Ukraine by the International Telecommunication Union and BASIC Association(a non-governmental organization from Japan). The telecommunication sector can no longer afford to be simply a carrier of traffic. Today's telecommunication community must not only understand new applications, but also be active participants in the development of those applications. We in the ITU are focusing on telemedicine, tele-education, environmental projection and remote and rural applications as examples of convergence-there are , of course, many more-and more particularly the socio-economic benefits to be derived from telecommunication development in itself and especially when applied to different sectors of today's fast-changing economy.

—The speech of Dr. Tyrjanne at the ceremony-

Originally these kinds of projects should be made under self-help by the governments or public organizations of the countries concerned. But it is the actual conditions that they cannot set to work to such improvement because of economic difficulties, administrative insufficiency and political disorder of the countries which have become independent recently. One of the doctors we have met there told us that he has been desperate of the current situation.

We also plan to renew PBX Telecom system in Yangon General Hospital in Myanmar, South East Asia. In this hospital where they handle tens of thousands of patients every year, the telephone system has been decrepit and doesn't function at all. Therefore it takes time for them to run around the vast compound. So capable doctors cannot execute adequate medical activities and in spite of emergency patients they are left alone at the outpatient counter because the specialist doctor cannot be called immediately. Our research members have instantly decided to renew the internal PBX system in this hospital. On the first stage existing analog telephones will be renewed and increased to 150 models and operator console and power supply system will be renewed for functioning. On the second stage we plan to let the whole system become digital and to increase the number of telephones greatly.

There seem a lot of needs to renew the existing PBX system like this kind. On the visit to Kiev of this time (October, 97) the plural number of hospital managers appealed us to do so strongly.

In the hospital facilities in these countries, much of the equipment was "contributed favorably" by foreign countries. In some cases buildings, equipment and medical apparatus were contributed and gathered separately by several countries, the rule of maintenance and repairs is insufficient and the budget is in shortage. Therefore it is sometimes difficult to set to work the task.

4. ORGANIZING TELECOM NGO AND PROPOSING "THE TELECOM AID ACTIVITY"

As we have learned these facts and situations, we began to think that these kinds of projects are not suitable for big aids or big business based on government or large companies.

One reason is that in order to find out their needs we have to carry out task work to probe the other party's circumstances elaborately, to watch the current facility and then have to take the measures to cope with the conditions. The large delegate by top executives cannot usually provide good service up to these. Second reason is that it is desirable for the persons in charge of research to have human motivations based on the sympathy with other party's pains and hardships. It is also desirable for them to have knowledge and experience of technology and system operations in order to grasp their needs and carry out the measures. The third reason is that each of these kinds of projects costs at most one hundred thousand dollars, so it is not fit for government or big companies. Moreover judgement and adaptability are needed to cope with changing small and large situations flexibly.
We have selected NGO as an organization possessing this kind of adaptability. We have previous history for our NGO currently composed of mainly veterans of Telecom. There used to be Telecom Foundation in accordance with Japanese law and they were tackling with the tasks of developing countries. When the Foundation was dissolved because of certain circumstances, above-mentioned IPHECA project by WHO arose and our Basic Association had recklessly decided to realize this plan in our NGO in 1992.

NGO is the abbreviation of Non Governmental Organization and it can give an idea unconventionally, look for possibility of its reality and carry out plans under our own responsibility. A variety of experience and ability are needed. Also not a few amount of money is necessary.

We have overcome this problem by reusing the current equipment in the first project. We cover management costs by collecting membership fees from people working for the company or related field. We have currently been receiving cordial medical advice from departments of medicines at both Nagasaki University and Tokai University.

In Japanese society based on free economy and democracy, not a few social aspects are still premature. We cannot say Japanese NGO activities or volunteering activities based on one's voluntary spirit are sufficient compared with Western countries. But since Hanshin Earthquake in Kobe in January 95 those activities seem to have been established in the Japanese society. We have come to handle the projects seemingly beyond our ability. Due to these works we have become conscious of our existence as a citizen in this society. Especially friendship made by people through these works is completely different from that of business world. I cannot refer to these socio-philosophical matters further more on this manuscript.

We dare to call these activities "The Telecom Aid Activity" because we can realize and confirm that Telecommunication is effective for improving basic welfare of human life depending on how we make use of it.
Our organization started in September 92. What we have accomplished in five years is not big at all, but we can surely realize how extensive and how big the future activities will become.

I would like to propose the following message. The persons concerned in Telecommunications field in the world, why don't we gather in each Telecom NGO, promote "The Telecom Aid Activity" and contribute to the global welfare, friendship and peace!

Telemedicine Through Shernet

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ABSTRACT

Telemedicine is a modern computer networking system used to offer real-time consultation for patients. Telemedicine Through Shernet (The Shanghai Education and Research Network) is the first real-time Telemedicine network project in China. This paper introduces the Telemedicine system now running on Shernet and discusses its prospects and impact.

I. Introduction

Telemedicine is a modern computer networking system used to offer real-time consultation for patients. The significance of Telemedicine to both the patient and doctor is very impressive. For patients, especially for those in the remote areas where the local medical service is often insufficient and its quality not good, they do not need to spend long hours traveling long distances for receiving the medical treatment at the medical centers in big cities. With Telemedicine it is possible for them to share, at their localities, the high level medical treatment from the best doctors living in different places in the home country and even in other countries of the world. For doctors, it is possible to acquire, through the Telemedicine system, the medical records of the patient stored at any hospital covered by the net. Various professional doctors are able to offer their consultation to improve the quality of medical service, and at the same time able to gain more experience and knowledge in their respective professional fields. The benefits Telemedicine can offer to both the individual and the society as a whole are becoming more and more aware in many countries. With the availability of advanced technology and financial resources, Telemedicine has found its wide application in the developed countries.

In China it is relatively late for Telemedicine to play a role in her social life. However in recent years big strides have been made with an eye to catch up. Supported by Shanghai Education Commission, the Shanghai Medical University began the project of Telemedicine System in 1995, to run on Shernet--the Shanghai Education and

Research Network. It is the first real-time Telemedicine network project in China. (Chen, 1995) In the same year, a large project named Golden Health Project was started and its sub-system called First Aid Network System was developed, with the result that part of the subsystem went into successful operation in 1996. The first electronics medical cards have started their way to serve the people in Shanghai and Anshan cities, as well as in Hebei and a few other provinces. The card holders can have the access in the first aid network system from any of the terminals, so that the doctors can read the medical records and decide what first aid assistance to offer. (Lu, 1996) A more recent example is seen from a news item on Jaifang Daily of Shanghai, August 14, 1997, reported by Xinhua News Agency from Beijing on August 13:

> With Golden Health Satellite Network, the experts of brain surgery in Beijing and Harbin conducted today, at different places, a successful "face to face" diagnosis for a girl of 12. The eight specialists are either from the First Hospital Affiliated to Harbin Medical University or the Beijing Golden Health Brain Telemedicine Center. After the consultation among them, an alternative of treatment was reached.
>
> Organized by the National Health Department, the exclusive Golden Health Medical Satellite Network has been opened into operation. Up to now the network has covered for the first batch of 20 hospitals spreading over 15 cities throughout the whole country. Among them are Fuwei Hospital of China's Medical Academy, the Third Hospital Affiliated to Beijing Medical University, and the First Hospital Affiliated to Harbin Medical University, etc..
>
> Anyone who possesses a "Golden Card" issued by the Bank of China can store his/her medical records into a hospital in the net and thus be able to receive the service of Telemedicine.

The events mentioned here and many more others emerging now and in the days to come have put us in a situation in which we have to keep a close eye on the development of Telemedicine in China. With this in view, let's take a closer look at the Telemedicine System Through Shernet.

II. The Telemedicine Through Shernet

The Telemedicine System of Shanghai Medical University is running on the Shanghai Education and Research Network (Shernet). Not long before, the first national specialized computer network, named China Education and

Research Network (Cernet) was formally initiated in November 1994. In order to construct the Shanghai Education and Scientific Research Network, Shanghai Education Commission set up a team to work on the project in April 1995. After the first stage of the project was completed, the network, Shernet, began its operation with a formal opening ceremony in January 1996.

With CONVEX-C240 supercomputer, SUB-SPARC20 stations, CISCO-2511 and CISCO-4500 route switches as its hardware, it is designed to take into consideration of the data communication capacities in accordance with the overall plan of Cernet. The Shernet trunk line adopts the DDN special line synchronous data transmission network, which is connected with star topology subnet. The major advantages of this structure lie in its reduced investment and good performance. The trunk line of Shernet now covers 10 knots, including Jiaotong University, Fudan University, Shanghai Medical University, etc., and offers the services of distance education, remote diagnosis, data retrieval, as well as routines like e-mail, homepage and FTP.

The Telemedicine System of Shanghai Medical University (RCS) began to run on Shernet on December 21, 1995. It was then the first real-time RCS network project in China. The system includes Shanghai Medical University and her seven affiliated hospitals which are connected to the network through campus network, with the other medical universities and larger hospitals in Shanghai connecting to the network through ISDN, DDN, X25 communication & satellite, or telephone lines. People can access the Center Database and ask for service through the telephone line. The system embraces 8 consultation management centers and various distinguished consultation centers, such as that of hand surgery, tumor pathological slice, liver cancer and medical imagination, etc.. The system has the capacity to carry out international Telemedicine with Macao, Singapore and San Francisco through Internet or satellite transmission.

The Consultation Management Center is responsible for allocating and controlling the consultation resources, both specialists and devices. Every consultation center is equipped with modern diagnostic computer system and other necessary facilities. Doctors from different hospitals or consultation centers are able to exchange their images, patient records and other information through the network and cooperate with each other through real-time discussion. The consultation center is designed to share medical information resources with other countries through Internet and become a member of the whole global public health network group.

Based on the multimedia computer,

the Telemedicine System of Shanghai Medical University adopts the technology and device of Intel and transmits the compressed data and the image information through Shernet, added by telephone lines, microwave, satellite and so on to the remote areas. In view of the present communication situation in Shanghai and the basic characteristics of Shernet, the system applies a two-level network structure with its core network on Shernet to construct a 64-2Mbps high-speed channel. The topological structure is so designed that high reliability, short network delay and economy are to be materialized. This helps get over the possible weaknesses of the Telemedicine on the telephone line with its poor quality and low transmission speed. The Telemedicine system, at the same time, can share the advantages of high transmission speed, low disturbance, cheap expenses from running on Shernet.

Now the Telemedicine System can offer remote image transmission (active or stable), whiteboard sharing, remote medical education, remote registration, Shanghai Medical Guide Database, medical seminar, medical science and technology information services. With the enlarging of its service scope covered by the system, the generally acknowledged benefits the society can get are increasing and gaining in importance.

III. The Social Effects of the System

The Telemedicine System's effects on the society are multi-dimensional. Generally, the more directly involved are the following aspects:

Patients can conveniently receive prompt medical help and service from experts at their own distant places. This will save them substantial time, money and efforts in acquiring timely and effective medical treatment. More importantly, the system can make it possible for those living in the poor, remote areas to enjoy the advanced medical services of Shanghai.

The network enables doctors to receive patient's records from Remote Patient Database and transmit X-ray Slice, CT or other kind of high resolution images. This will largely reduce the medical expenses which would otherwise be very high, and result in the assurance and improvement of diagnostic qualities.

For each health and medical care organization, the system helps avoid duplicate investments of the like equipment, so as to reduce constructive cost, but with improved input-output effects, because the system will make all the high quality, excellent and sophisticated medical devices be allocated and shared more properly.

Through the network, workers in the health sector can conduct remote education, academic exchanges and discussions between different areas. This will enhance the popularization and prevailing of health and medical knowledge of the whole nation, and contribute to closing the gap of living conditions between people living in different areas in our country.

People can access to the network via telephone lines for the database of the service center. This, in a sense, brings the outside medical information world into the home of an individual with an opportunity for each to receive health and medical education, and in turn, promotes the production and sales of the telephone related communication products.

The significance of the services from Telemedicine is far beyond those directly related to people's health care and medical treatment, and to the health and medical education of the people. With the development of Telemedicine systems in many other countries, the communication stimulated by Telemedicine services the world over will bring about more significant evolution or revolution in medical theories, in people's world view and in forming a new and more integrated human civilization in the next century. Since more and more people from different cultures will have to communicate through Telemedicine systems, the exchanges and interactions between peoples in different parts of the world will probably achieve the following results (Cui, 1996):

1. Accelerating the process of integrating the Western and the traditional Chinese medicine.
2. In the process of this integration, a kind of mutual understanding will have to be reached in terms of the medical philosophy in both the Western and the Chinese Medicine.
3. This mutual understanding can only be realized through overcoming the obstacles in language communications.
4. In overcoming such obstacles, a standardization of terminology in medical terms would have to be fulfilled. This process might be called the globalization of medical terms.
5. Then a new discourse will in this way be created to address a new theoretical system for the explanation of the phenomenon in the respect of human health and medical care.
6. In all this process, the world peace and development will possibly come true and a new light will cast in the life of human society.

As is known, whatever a new thing it is, when appearing on the scene of the human history, it can not be perfect at the early stage. Both the far-reaching effects of the system on our society in terms of economic and social benefits, and the problems coming with it, are largely open for further discussions. With Telemedicine entering our society, more specifically we have to ask: What kind of patients are suitable for Telemedicine? What would be the cost-effectiveness in this service? What are the existing and potential managerial problems for us to solve so that the effective and efficient operation of Telemedicine can be made, especially when this system grows into enormous size and becomes more comprehensive? What shall we do to prepare the related rules and regulations for the normal operation of this system? What are other potential problems we will have to solve when the system offers international Telemedicine services for average people?

Although there might be more problems lying before us, we are not to be discouraged. Instead, humans are always encouraged and inspired by their beautiful dreams. The significance from Telemedicine services is far beyond those directly related to people's health care and medical treatment. The development of Telemedicine System Through Shernet has just started and there is still a long way to go for us both in theory and practice. It is hoped that the sharing of such information would invite more discussions and be beneficial to us all, and more contributions will be made in the years to come both in China and other parts of the world.

References:

Chen, Yin, *Consultation Through Telemedicine--a New Approach in Medical Service*, in Shanghai Medical University Newspaper, No. 344, November 15, 1995.

Cui, Liang Yi, *The General Trend of Integration, Supplementation and Innovation of the Eastern and Western Medicines*, in Medicine and Computer, No. 2, 1996.

Lu, Ping He, *The Development and Application of the First Aid Network System in the Golden Health Project*, in Medicine and Computer, No. 2, 1996.

CDPD Technology and Mobile Computing

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1. ABSTRACT

A growing number of web pages and information banks (IB) are being constructed for corporate Intranets. The current technology can build an inexpensive wired / wireless Intranet site that, in addition to minimizing graphics, uses a standard browser like Netscape and TCP/IP protocols - thus permitting access to the web site or IB via a Cellular Digital Packet Data (CDPD) network.

2. INTRODUCTION

Telecommunication development is indeed an amazing event in these years, and will further change our lives in the next century. The world is getting smaller and smaller, and our work becoming more and more wonderful. The success of Internet brings up the new concept of Virtual World, including Virtual Shop, Virtual Library, Virtual TV, etc. This greatly changes the traditional style of life and make our working custom contradictional: why we must spend much time in the jammed traffic to go to the office while the Virtual Office is available at home; why we must send the kids to the far-away school just for one course while the Virtual School is open at home. In the meanwhile, the Virtual Shopping and Virtual banking are already popular in our daily life.

Whatever it happens, it is an advance in terms of civilization and progress. The most of the achievements result from the rapid development of information technology and telecommunication network.

How to extend the Internet services to the mobile application is the new growing demand. In order to make full use of the existing cellular frequency spectrum and Internet application tools, the Cellular Digital Packet Data (CDPD) network is an optimal solution.

3. CDPD TECHNOLOGY

CDPD was announced in 1992 as an alternative way to send and receive data over the existing cellular network. The intention was to develop a method where short messages and data could be sent in between voice calls using much of the same infrastructure. At the time of its initial development, circuit cellular data calls were slower and less reliable, so virtually anything would be an improvement.

CDPD is a packet technology, that is, it sends small packets (usually up to about 1,500 bytes) of information for small bursts of time, while technically, files of virtually any length may be sent, the network is optimized for fast, low cost transmission of smaller files. Since the data (such as messages) is often sent in small amounts, users are not as concerned with throughput, as they would be with circuit switched data (where you are paying for time, not data).

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CDPD is designed as an IP network. It does not use phone numbers directly, rather it uses address for everyone on the network.

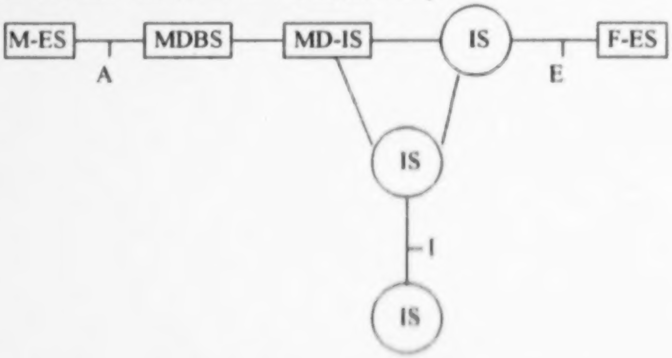
As such, you would not directly dial the modem on your desktop as you would be with circuit switched data, rather you would send a message to an address which could go through a gateway to your LAN, then to your desktop as another node on the network.

CDPD uses a modulation technique known as Gaussian Minimum Shift Keying (GMSK) to modulate the carrier in a full duplex mode (forward and reverse channels). It also uses a forward error correction technique known as Reed Solomon coding. Due to network and protocol requirements (including the error correction), the raw modulation rate of 19,200 baud is reduced to about 9,600 bits per second of actual user data on an unloaded system. This data rate is relatively constant while the CDPD user has grabbed a channel for single or multiple packets. However, depending upon the network, the actual implementation, and the user load (including voice), actual CDPD channel control by a single user (channels are shared by multiple users) can be as low as 10% (often referred to as the access duty cycle, which in this case is 10% on, 90% off). Thus, user throughput with multiple users can range from around 960 bits per second (bps) to 9,600 bps depending on system load. These figures are raw and do not include compression. In actual use, we perform necessary data compression (i.e., V.42 bis), and the true user throughput can reach around 38.4kbps.

Since CDPD is billed on a per packet and / or per byte basis, short messages and small inquiries can be very cost effective in comparison to circuit switched cellular. Due to its "addressing" nature, CDPD easily meets the needs of two-way messaging today.

CDPD is a connectionless packet data system. That is it could take several seconds for your data to be received by another address. In some cases, this might be less convenient to use in a remote access application where high data rates and quick response are required. However, CDPD has no connection time wasting, and connections can be made instantaneously.

The proposed CDPD Network Reference Model is as follows:



F-ES : Fixed End System
IS : Intermediate System (provide network relay function)
MDBS : Mobile Date Base Station
M-ES : Mobile End System
MD-IS : Mobile Data Intermediate System (perform routing function based on current location of the M-ES)

Fig 1. CDPD Network Reference Model

Currently, the CDPD New Design and System Enhancement include:

1. Automatic HDD update procedure > To define the Mobile Network Location Protocol (MNLP) with the ability for the home MD-IS to inform the serving MD-IS about updates to the Home Domain Directory (HDD).
2. RRM "forced hop" efficiency > Radio Resource Management (RRM) procedures have been defined to favor "planned hop" procedures. Inefficiencies may result if the system predominantly relies on "forced hops".
3. CS-CDPD Call-back > Circuit Switched (CS) CDPD provides capability for system to "call back" to allow network initiated reconnection.
4. IPv6 & Mobile IP > To support multiple connectionless network protocols, including Internet Protocol version 6, and Mobile IP.
5. PPTP > To support Point to Point Tunneling Protocol (PPTP) to establish virtual private networks and enterprise networks.
6. CALEA > To support CALEA to address data interception, data rerouting, intercept initiation / termination functions and protocols.
7. Bi-lateral authentication extension > To support authentication of the mobile unit by the network.
8. Initial activation / provisioning > The CDPD maintains authentication credentials for Network Entity Identifiers (NEI). However, prior to the first registration to the network, the authentication credentials may be vulnerable to fraudulent misuse. Mechanism to reduce this window of vulnerability need to be designed.
9. Accounting system Interface > To support multiple RF airlinks, including circuit switched access, CDMA RF access, TDMA RF access, common interface to accounting system is essential.
10. Encryption alternatives / extensions > To define the use of RSA RC4 encryption algorithm for data transferred over the airlink.
11. Wireless Data Management > To describe the Wireless Data Network Management system, including service management, connection management and fault management.

4. ISDN INTERNETWORKING

As an example, we connect the CDPD with the ISDN (Integrated Service Digital Network). By multiplexing several CDPD channels (i.e., 1 ~ 8) into the ISDN B-channels, we can obtain higher wireless data transmission up to 600kb/s which is suitable for low-speed multimedia transmission (the real-time multimedia transmission requires at least 2Mb/s datarate, which is not reachable in cellular networks so far). Meanwhile, we propose to explore the XTP-Lite/ST-II protocol [2] to replace the normal TCP/IP protocol (XTP-Lite/ST-II is compatible to TCP/IP) for the multimedia services since the existing TCP/IP has no mechanism in dynamic rate control and therefore can not guarantee the QoS (Quality of Service) in transmission. The following figure shows the protocol stack for this system under independent CDPD infrastructure, where 'LAPD (Q.931)' is the ISDN signaling system with slight modification of CDPD's shared medium feature; 'Mobile TCP/IP' handles the mobility control and Handoff issues for the CDPD packet transmission. In this way, the CDPD network can be a separate wireless link provider instead of relying on other cellular networks. 'CDPD Network Management' includes ISDN management protocol plus CDPD Mobile MIB (Management Information Base) module, which extends the ISDN service management, Channel management and Fault management to the wireless mobile hosts. 'Network Adaptation' provides an interface socket between IP and lower media access control protocol. RS (Reed-Solomon) Code with appropriate interleaving depth is used in the Link Layer. Other issues about this configuration can be referred to in [3].

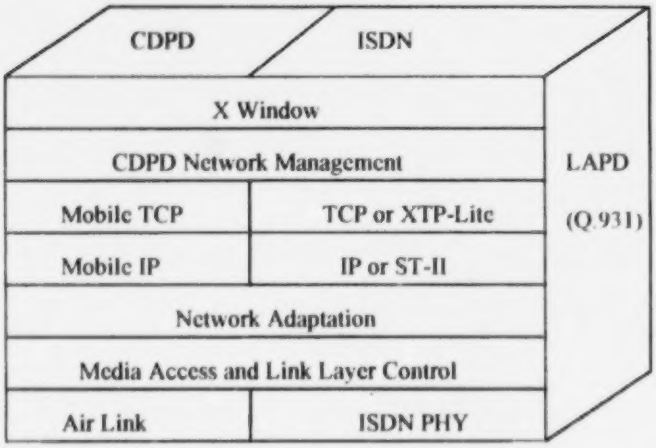


Fig.2: Proposed CDPD / ISDN Infrastructure

5. ON-SITE APPLICATION

In order to maintain a high level of productivity in research as well as in designing work, it is crucial that we be up and running in our labs in the shortest time possible. As we seek ways to shorten our start-up time, we realized that being able to use personal laptop computer, rather than "borrowing" a desktop computer, would go a long way toward saving valuable productivity time. But how could we attach our laptop to different networks and still be able to roam freely among these various lab sites ?

A CDPD wireless connection is the obvious answer. Therefore, we connect the laptop to the CDPD network to meet all of our criteria: good range (300 - 800m and more), good throughput (38.4 kb/s and more), affordable price (around $400 per unit), ease-of-use and software-independence.

Now when we arrive on-site at different labs or offices for mobile computing, we come equipped with our laptops CDPD unit attached and a second unit which we attach to the local network. Once connected, we operates like any other node on the network. However, our 38.4kb/s wireless connection lets us roam wherever we need to. Since our laptop is already configured and loaded with all the software tools we need, once we connect to the local network we can begin testing and debugging a software application immediately. If during testing the local host finds a defect in the application, we edit the code on-the-fly and then use the IDE located on the local network to rebuilt the application. Using the same computer and development tools used to create the application shortens the testing and debugging process. This not only saves the time, but also enables us to offer better service.

Real-time software in mobile computing also specializes in designing web sites and we have found that CDPD wireless networking can boost productivity in this area as well. We frequently give on-site presentations that involve accessing the Internet or Intranet. We can simply connect the laptop to the local network via the CDPD airlink and access the Internet via the ISDN line. Faster

Internet access speeds our presentations and wastes less of our time.

Fig.3: CDPD Network Application

CDPD connectivity gives us a definite increase in productivity, raises the level of service and offers the additional benefit of greater flexibility in our work environment. If beautiful spring approaches, we can migrate the entire office to the great outdoors. We will be able to work from our own back porch where we can enjoy the beauty first-hand - an unexpected, but welcome benefit.

6. ACKNOWLEDGMENT

Thanks are given to the DELSON Laboratories for their support of the Broadband CDPD Channels and ISDN/ATM Test Beds during the system test work.

7. REFERENCES

1. Technical Specification sheets, MOTOROLA CDPD system, 1993.
2. W.Lu, CDPD Mobile Data Network, Technical Report, DELSON LABS, 1996.
3. W.Lu, System Architecture of Lower Layer for the Wireless Mobile ATM Integration, Globecom'97, Nov. 4~8, Phoenix, USA, 1997.

Intelligent Satellite Overlay Networks Enable Quick Deployment of Future Internet Services

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Abstract - While wildly successful, the true power and impact of the Internet has yet to be fully realized. New push, streaming, and IP multicast technologies can distribute audio, video and real-time events with true worldwide coverage. The existing paradigms in radio and TV broadcasting, newscasting, live event coverage, and software and information distribution will change as a result. Yet deploying these technology advancements into the existing Internet backbone and multi-layered wired infrastructure will take time. Overlaying the many layers of the existing wired Internet infrastructure with satellite enabled services can deploy these new services much more rapidly.

Introduction

Recent headlines in telecommunications periodicals dub the Internet as the "World Wide Weight," referring to the "star" network of the Internet—with the backbone centered squarely in the United States and the end points in the rest of the world. Others speak tongue-in-cheek of the "World Wide Wait," which is but one artifact of the former and refers to the congestion appearing not only in geographically remote regions, but also within the U.S. backbone as demand far outweighs capacity.

Take for example the following statistics. India, a nation of over 900 million people, has access to approximately 10 Mbps of international Internet capacity. Russia, with only 150 million people, is expected to have quite a bit more by 1998, somewhere in the neighborhood of 40 Mbps. Demand is high in Asia, Latin America and Africa, while capacity is similar to that of India. And as new fiber capacity comes online at the end of 1997 in Asia, over-subscription abounds to the tune of four times available capacity. How can the Internet become a truly international resource, where throughputs match demand? The answers won't be found overnight, but by providing intelligent satellite based capacity, optimized for Internet access and applications, solutions can begin to be implemented today.

Where did the Internet come from and what is the Backbone?

The Internet began with packet switching projects in the late 1960s, primarily attributed to the Advanced Research Project Agency ARPANET. During the 1970s the network grew to support many organizations in the U.S. Department of Defense, other government agencies, and to support universities and research organizations. In the early to mid-1980s, the Transmission Control Protocol and Internet Protocol suite (TCP/IP) was developed to interconnect the numerous computers and networks effectively. By 1985, the ARPANET was heavily used and extremely congested. The National Science Foundation founded the interconnection of six supercomputer centers using point-to-point links known as NSFNET. In 1987, a new award was made to upgrade and operate the NSFNET backbone. This network was based on T1 circuits, and connected some 13 regional networks and the supercomputer centers. After commercialization in the early '90s, the new Advanced Network and Services (ANS) was formed reaching interconnecting speeds of 45 Mbps (DS3).

Today the Internet "backbone" is predominantly a collection of U.S.-based high capacity networks owned by 22 companies. These networks are interlinked (full mesh) passing traffic between themselves (around the backbone) and their customers, Internet service providers (ISPs) and private (corporate) intranets. ISPs in turn provide low to medium speed connections to consumers and corporate users. Network access points (NAPs) serve as a means for moving data between the backbone and the ISP networks in a manner that does not restrict which internetworking protocol or routing policy is used. Connectivity between the NAPs is made with speeds ranging from DS3 (45 Mbps) to OC12 (655 Mbps) and is capable of supporting hundreds to thousands of ISPs. To date the extension of the "backbone" outside of the U.S. has been slow. Europe currently has a hand full of NAPs with backbones ranging from 2 Mbps to 34 Mbps. Fortunately this number is growing and spreading to northern Europe with 155 Mbps links within national boundaries.

Some industry experts are forecasting that while 80% of international traffic is voice today, within five years only 20% will be used for voice. Because of the reasons cited previously, among others, there is considerable interest in expanding the worldwide connectivity of the Internet at very high speeds. One such project is the Fiber Optic Link Around the Globe (FLAG). Yet fiber infrastructure deployment takes considerable investment and time. Furthermore, as we shall see in further discussions that follow, there are other technologies that need to be deployed to make the Internet "healthy" once again.

What's Behind the World Wide Wait and What Can Be Done About It?

There are a number of issues behind the congestion and overall poor performance of the Internet as seen from users within the United States and beyond. We present a number of reasons for this poor quality of service (QoS), with a proposed related technology solution. (These solutions are explored in later sections.)

1) As most everyone knows, the use of the Internet has risen rapidly in the past five years. The means of searching and viewing information has transitioned from the language of computer whizzes such as telenet, gopher, and Archie to point-and-click graphical web browsers complete with sound and animation. This more graphically-rich, multimedia (video and audio) content has created even greater demands for transferring large amounts of data between the source (server) and the user (client). Existing capacity is insufficient to handle the demand.

Solution: Use existing bandwidth more intelligently. Replicating this information as close to the end-user as possible on alternate host machines can free all intermediate connections and bandwidth for other uses.

2) Another phenomena of the Internet is that most of the traffic pattern (approximately 80%) is pulled from a relatively small number of server sites (20%). It is also interesting to note that over 80% of Internet content is English language based, once again indicating that those outside of the United States need to connect to the backbone more often than not.

Solution: Use existing bandwidth more efficiently through data replication and large scale caching (storage) at key traffic nodes — content is then available "locally" or at worst, within a closer region. Since the information source is now only restricted by local data paths, the quality of service can increase significantly. In the ideal case this concept could extend directly to the end user PC.

3) Yet another noteworthy aspect of content traffic is the very significant 10:1 ratio of data leaving a server compared to the data entering a server from a user. Traditional terrestrial connections do not support this asymmetric traffic loading—only full duplex symmetric circuits are available with unused bandwidth capacity left idle.

Solution: Implement asymmetric circuits to the ISP points of presence—something that satellite technology is excellently suited for. High speed multiple Mbps (e.g., 1 - 45 Mbps) outbound carriers deliver the content from the server, while lower speed (e.g., 64 Kbps to 1 Mbps) inbound connections handle user requests. The saved bandwidth can then be used to provide yet more outbound capacity. The result—greater throughput and higher quality of service (QoS). (The inbound circuits are used to query data, interactive sessions or for protocol support—implementing them as simplex circuits to save satellite bandwidth and power.)

4) New subscription-based services (like Pointcast) are meeting a very important market need. Users are more interested in having focused information delivered to their PC for immediate viewing rather than having to send a query (pull) for the information—in short, information finds you. An appropriate analogy is walking to a newsstand to buy a newspaper (pull) or having it delivered to your home each morning (push). Because TCP/IP is a connection-based reliable protocol, these new "push" services must transmit the same data over and over again (N times) until all (N) subscribers receive the information and confirm reception. Or if user datagram protocol (UDP) is used for unicast connections, there are still N transmissions required.

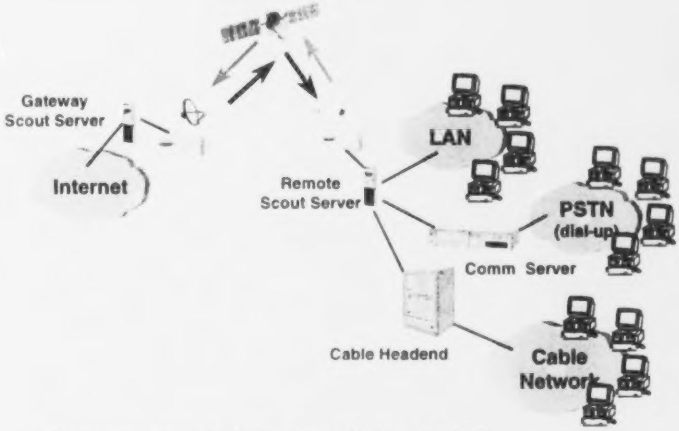
Solution: Implementing IP multicast in the network, sends data to all subscribers with a single transmission, thereby greatly reducing the amount of data on the network by a factor of N-1. There is a basic standard for managing IP groups known as IGMP (Internet group management protocol). However, there are a number of challenges for updating routing paths, joining and leaving multicast groups, streaming protocols, etc. Compatibility between router vendors is also an issue and has led to a rather slow rate of adoption in the terrestrial wired Internet world. Currently only small private networks support multicasting. A satellite-based solution can bypass the terrestrial infrastructure and directly connect users to the host server. With an IP multicast enabled satellite overlay network ISPs and network access providers (NAPs) can roll out advanced services, improve network response time, customize service offerings, and increase revenue.

Technologies that make a difference

Now we will look at three different technology approaches that enable the presented solutions and, when implemented together, result in a very powerful package:

1) Replication and mirroring content
2) Asymmetric links with dynamic capacity management for load balancing
3) IP multicasting

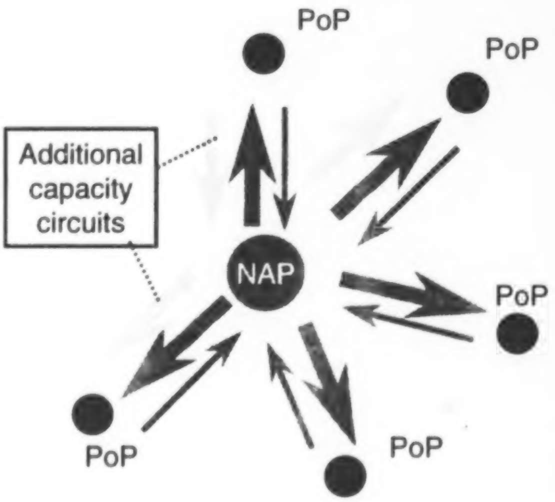
As mentioned earlier, replicating data and distributing the content to mirrored server sites that are reachable by local connections can significantly reduce data access time — also freeing up the transport channels for other services. The local connections at the mirror server sites can be LAN, dial-up terrestrial or cable TV distribution plants as shown in the diagram. The cable plants have the potential for providing the highest local loop speeds—even up to 45 Mbps per cable channel. To be effective in providing content at the speed of the cable channel, large amounts of data (5-50 Gbytes or more) should be stored within server(s) at the head-end. Management of this mirrored data is important to ensure that content is current. Mirroring can be implemented using web-prefetching, replication and auto-update along with smart caching.



For lower bandwidth client links, the ISP implementing the service installs a server PC at each point-of-presence (POP) within their desired service area. (An ISP can even install several POPs within a major service area). In this scenario a lower speed wide band IP multicast channel operating at 0.5 to 8 Mbps is transmitted from the Internet gateway access point (or primary host site) to all POPs. The return channel can be established on demand or (although much less bandwidth efficient) permanently assigned. The return channel carries user queries that aren't satisfied from the local server and replication error recovery data. The users dial into their local POP over telephone connections. Most (if not all) information is available on the local server. There are no Internet access or satellite latencies—the information is pulled directly off the hard drive and sent immediately to the end-user.

When interconnecting these PoPs to the gateway, use of space segment use should be optimized, to reduce operating costs or maximize the quality of service. In actuality, both are achievable. First, asymmetric links should be used, with the greater bandwidths allocated for the outbound channels from the Internet to the PoPs. This is possible since most (70-80%) of the traffic is from the web server. The capacity savings gained in not using symmetric links can be used to increase the outbound channels or to implement variable capacity overflow circuits. These special overflow circuits can be activated when a bottleneck occurs in either direction (to or from the PoP). This additional bandwidth is allocated only when needed and wherever congestion exists. With this approach less bandwidth needs be pre-allocated for the permanent circuits, with more bandwidth allocated for the overflow capacity that can be shared among all sites.

In contrast, typical satellite permanent circuits have fixed capacity, so some POP interconnections will be overloaded while others are underutilized. With dynamic capacity, permanent circuits can be sized for 80% of peak and the remaining bandwidth across the network is allocated for dynamic overflow circuits. In this way, higher quality of service is ensured, especially if the interconnecting network is across multiple time zones.



IP Multicast is an IP protocol that permits transmitting the same information to more than one receiver at a time. The most widely used transport protocols are TCP (transmission control protocol) or UDP (user datagram protocol). TCP/IP is a reliable, connection-oriented protocol while UDP is an unreliable, connectionless protocol. Both however share the same characteristic in that there is one transmitter and one receiver in each transmission session. So if 2,500 sites require the same software to be downloaded, then 2,500 FTPs would be required. This is a considerable drain on bandwidth resources, not to mention all the time spent transferring 2,499 more times than absolutely necessary. With IP multicast, the file could be transmitted once using a single group address for all 2,500 sites.

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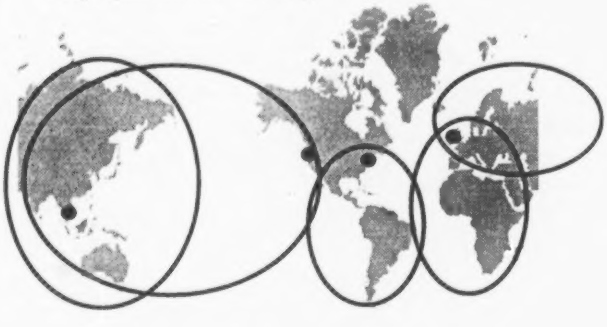
The Satellite Overlay with the Terrestrial Internet

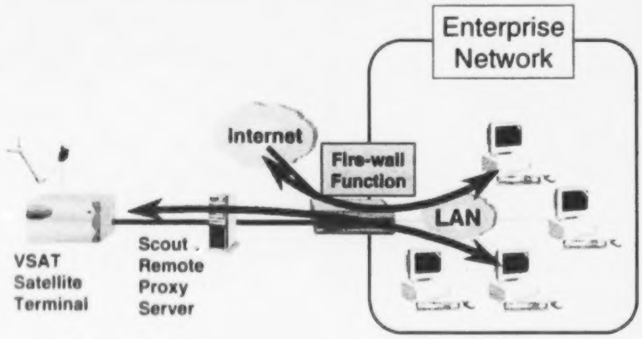
Over 80% of Internet content resides on the U.S. backbone. For more effective user services worldwide, providers need to extend high speed access and implement in region infrastructure. High speed (2-155 Mbps) satellite circuits from the network access points (NAPs) to the desired terminating sites can achieve these services. A partial list of Internet NAPs is provided in the following table. There are over two dozen locations in the U.S. alone.

United States • MAE East (MFS) • MAE West (MFS) • MAE LA (PAC Bell) • MAE Houston • MAE Dallas • MAE Chicago (Ameritec) • MAE New York (Sprint)	**Europe** • MAE Paris • MAE Frankfurt • French (GIX) • Amsterdam Internet Exchange (AMS-IX) • Stockholm Exchange (DGIX) • London Internet Exchange (LINX) • Belgium IP Interconnect Point
Pacific Rim • Hong Kong Internet Exchange • New Zealand Internet Exchange (NIX)	**Middle East** • Israeli Internet Exchange

As the diagram shows, satellite links with gateways located at key sites can serve whole regions. These links, if supporting backbone interconnects, would be symmetrical or slightly asymmetrical depending on traffic patterns. While supporting backbone interconnects the same NAP facility can be used to provide ISPs with traffic capacity as discussed in the previous sections. These ISP satellite gateways can be located on-premise and may also support corporate clients directly.



Incorporating IP multicast, push-services, web site mirroring and smart caching brings ISPs new never-before offered value-added services.



The above diagram shows an enterprise network site configured for a terrestrial connection to the Internet. For more advanced services, the properly enabled satellite network can connect to the existing network equipment and provide a seamless, transparent overlay. This hybrid system provides the best of both worlds, and can even provide an enterprise-wide intranet through the VSAT terminal.

Wrap Up

The Internet has become a casualty of its own success—too much demand, not enough capacity thereby creating "traffic jams" on the information superhighway. What is needed is a "high occupancy vehicle" lane that expedites traffic to where it's going. That is exactly what IP multicasting can do for the Internet; carry lots of traffic to more than one place in a single package. Coupling IP multicast with web-site replication and distribution can support considerably more users with consistently higher QoS levels.

Furthermore the technology can extend the Internet backbone and ISP services to international locations where access has been difficult, if not impossible. And these new NAPs or ISP PoPs can be implemented in days or weeks, not months and years. Capabilities such as adaptive and flexible rate routing and high-speed asymmetric connections focus performance where it is needed while saving bandwidth costs.

Clearly IP and the Internet are changing the way in which the world communicates. Satellites, with integrated IP services and dynamic bandwidth management (DAMA), not only provides the highest quality of service levels possible, but also offers IP multicast-based push services that are not yet possible in the "wired world."

Internet Roaming: A Solution for Global Internet Access

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1. ABSTRACT

In this paper, we identify and discuss the various issues and solutions in the design and implementation of Internet roaming, among the most important being user authentication, ISP server routing, and settlement between ISPs. Essential technical, financial and business issues are therefore discussed for Internet roaming. Finally, the impact of Internet roaming in the Asia Pacific region is examined.

2. INTRODUCTION

Internet roaming has been widely accepted as a convenient and economic way of providing dial-up global Internet access by Internet service providers (ISPs) to their customers. The economics is in comparison with the traditional way of making long distance or international calls for a user to connect to the Internet through the home ISP with which the user has established an Internet service relationship. Internet roaming is most appealing to small ISPs whose networks only cover relatively small areas for it helps these small ISPs to expand their virtual network coverage for user access. It is also most appealing to frequent travelers who may go out of the areas that their ISPs provide a coverage. Most importantly, Internet roaming costs much less than dialing long distance or international calls to connect users back to the home ISPs for Internet access.

Internet roaming is defined as a user to use another ISP's network (the local ISP) to gain Internet access while maintaining the service relationship with a different ISP (the home ISP). Internet roaming requires the establishment of a business relationship between ISPs to serve each other's customers. The business relationship ensures that the ISPs will become known to each other so that user requests for Internet access can be routed by a local ISP to the correct home ISP for verification. Therefore, there is no sharing of user information needed between these ISPs. To support the roaming technical requirement, there are two key issues that have to be resolved: user authentication and ISP server routing. These and other technical issues will be discussed in Section 2 on Internet roaming technical issues and solutions.

Since, in an Internet roaming situation, more than one ISPs are involved, the local ISP that provides the actual Internet service will expect to receive payment for the service. Furthermore, since the local ISP does not have a formal service relationship with the user and does not have sufficient information about the user to be able to bill, it is natural that the payment will be made by the home ISP. This type of financial arrangement is also highly desirable to the user because the user then will only deal with a single ISP, i.e., the home ISP, no matter how many local ISPs the user has used for Internet roaming during a previous billing cycle. To support the roaming financial requirement, there is the issue of settlement between ISPs. Since customer billing by an ISP, whether it is for Internet roaming service, is generally considered to be a local issue, it is not addressed in Internet roaming solutions except that the roaming transaction records have to be made available to be integrated into the local billing system. These and other financial issues will be discussed in Section 3 on Internet roaming financial issues and solutions.

Given the large number of ISPs (around 4,000 in the U.S. and 7,000 in the entire world), it is very difficult, if not impossible, for an ISP to establish and maintain a business relationship with each and every other ISP to enable global Internet roaming. To maintain a flexible and scalable global Internet roaming network, business relationships between ISPs can be better served by ISPs' forming an alliance or a consortium with a central administration that acts as a clearinghouse for resolving certain technical as well as financial issues. This central administration will take the responsibility of maintaining the roaming network as well as of settling charges and payments between ISPs. Each ISP will then need only to establish and maintain a business relationship with the clearinghouse. Subscription of Internet roaming service will simply become a matter of joining the consortium. These and other business issues will be discussed in Section 4 on Internet roaming business issues and solutions.

Finally, the impact of Internet roaming to the Asia Pacific region is discussed, which can be best illustrated by the active participation of ISPs in the region in one or more global Internet roaming consortia and the areas that have already been covered by the consortia. Conclusions to this paper will then follow this study.

3. TECHNICAL ISSUES AND SOLUTIONS

Since Internet roaming requires the cooperation of two ISPs, with one being the home ISP with which the user has established an account and the other being the local ISP that provides the actual Internet service, the following two issues have to be resolved:

(1) User authentication: since the local ISP does not have any information about the user, authentication has to be performed by the home ISP.

(2) ISP server routing: since the user may be from any one of a group of ISPs, the local ISP needs some mechanism to derive the correct home ISP that will do user authentication.

3.1 USER AUTHENTICATION

User authentication involves communications between the local ISP and a home ISP. This is because user authentication establishes the accountability of the transaction and, therefore, must be done by the ISP that owns the user and has the user's information. To facilitate roaming, when the user logs on to the local ISP, the user has to provide the domain name that will identify the home ISP that the user belongs to, in addition to the traditional user identifier and the password. By examining the domain name of the user login information, the local ISP is able to determine whether the user is a local user or a roaming user. If it is a roaming user, the local ISP will send the user information to the home ISP for validation. The mapping between a domain name and an ISP is the function of ISP server routing, which is the subject of discussion in the next subsection.

The home ISP, after receiving a user authentication request, will also examine the user information received against the user database information it has to determine whether this user is a legitimate user. If the authentication succeeds, a "yes" response will be sent to the local ISP to authorize it to offer Internet service. The home ISP may require further user authentication steps such as one-time token before finally authenticating the user. In this case, a response containing information and request for further authentication is sent back to the local ISP. The next round of user authentication from the local ISP will resemble the first one based on user identifier and password but will use a different set of values supplied by the user. There is no major difference in principle between the different authentication mechanisms. The final goal is for the home ISP to reach a user authentication decision to authorize or not to authorize the local ISP to offer Internet service to the roaming user. If not authorized, the local ISP will reject the user and tear down the connection because the local ISP would not get paid by the home ISP should it decide to proceed otherwise.

3.2 ISP SERVER ROUTING

After the local ISP determines that the user is roaming user, it needs to derive the server routing information of a home ISP where a request can be sent and user authentication can be carried out. There are three approaches to accomplish this function: distributed routing, centralized routing information and centralized routing implementation. In distributed routing, routing information is stored and maintained at each ISP so that the local ISP can use the domain name information supplied by the user to derive the home ISP server information. The advantage of this approach is that it is fast because the routing information is always available in the local ISP site or network. The disadvantage is equally obvious, that is, it does not scale very well; therefore it is not easy to implement and maintain given the large number of ISPs in the world.

The solution to the distributed ISP server routing problem is to centralize the routing information. With the centralized routing information, there are two approaches to perform actual routing of user authentication requests. In the first approach, the local

ISP will query the central routing server for routing information to the home ISP. The actual routing will still be carried out by the local ISP based on the routing information obtained from the routing server. This process of routing information query essentially translates the domain name supplied by the user to a routable address, e.g., the IP address, in order for the local ISP to address a user authentication request to the correct home ISP. The routing information will normally be cached at the local ISP to improve performance; therefore, future user requests with the same domain name will not require the querying of the central routing server.

In the other approach, the local ISP will route all the roaming requests to the central routing server. That is, the server will involve in each and every user authentication transaction; it becomes a central node in the user authentication chain. This approach allows the central routing server to perform better network control but suffers severe network performance problem because the delay of every authentication request and reply will virtually double. This way of implementation will perform the worst if the local and the home ISPs are connected via high-speed network links but their connections to the central routing server are relatively poor.

4. FINANCIAL ISSUES AND SOLUTIONS

Each Internet roaming transaction usually involves two ISPs, i.e., the local ISP and the home ISP, although, in certain applications and environments, there could be other ISPs in between them. Since Internet roaming has to involve financial transactions between the local and the home ISPs, this flat structure of ISPs in a roaming network makes it impractical for individual ISPs to settle financial transactions with each other. This is because ISPs must establish mutual trust relationships with each other on financial issues. Furthermore, it may not be economical for an ISP to deal with each and every other ISP for financial settlement. Therefore, it is inevitable that some arrangement must be set up to resolve financial issues between ISPs regarding Internet roaming.

There are three issues that have to be addressed:

(1) Pricing structure: since there is more than just the home ISP in a roaming situation, the pricing structure of the Internet roaming service will no longer be simply determined by a single ISP.

(2) ISP settlement: since Internet roaming involves more than one ISPs, the financial settlement has to be arranged and has to be flexible and scalable.

(3) User billing: since Internet roaming is generally offered to customers by ISPs as a value-added service, the ISP existing billing systems have to be enhanced.

4.1 INTERNET ROAMING PRICING

Given that the local ISP and the home ISP play different roles in Internet roaming with the local ISP providing the network and service and the home ISP providing the user, both ISPs need to be paid by the user. Thus, Internet roaming pricing includes at least two components: charges by the local ISP and those by the home ISP. The charges by the local ISP are primarily based on the cost of providing network service. On the other hand, the charges by the home ISP are related to customer services, which include, but are not limited to, account management and administration, billing and payment collection and handling to the local ISP. If a clearinghouse model is employed to handle financial transactions between ISPs for Internet roaming service, an additional component has to be added to the pricing structure, i.e., the charges by the central clearinghouse agent. It should be noted that the addition of a clearinghouse in the pricing structure does not necessarily lead to a higher price to the end users. While the charges by the local ISP will mostly remain the same, the charges by the home ISP can be substantially lower. This is because the central clearinghouse agent now takes over some of the work that otherwise has to be done by the home ISP, noticeably the financial transactions between the home ISP and the local ISP. The agent might also be able to aid in the customer billing of the home ISP thanks to the detailed transaction records that usually accompany the invoice from the agent to the home ISP. In addition, the centralized clearinghouse may handle the settlement more efficiently such that the overall cost of inter-ISP transactions can be greatly reduced. This reduction will be reflected in the home ISP's cost structure and the savings should ultimately go to the users.

4.2 ISP SETTLEMENT

ISP settlement can be carried out on a peer-to-peer basis. This will work fine if the number of ISPs in a roaming network is small. In reality, due to the existence of a large number of ISPs in the world, any Internet roaming network will be expected to grow to

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have a substantially large number of ISPs. The existing Internet roaming consortia such as GRIC and iPASS Alliance can demonstrate this. For scalability reasons, a clearinghouse model is, therefore, more suitable to Internet roaming to handle financial settlement between ISPs. Another advantage of having a centralized settlement agent is that an individual ISP needs only to trust and deal with the agent for all issues related to the roaming network. Peer-to-peer relationship is no longer needed and maintained under such circumstances. This would contribute significantly to the streamlining of the network operations and to the lowering of the overall cost of Internet roaming.

4.3 USER BILLING

User billing in Internet roaming is generally considered to be a local issue. That is, billing should be handled by the home ISP. At a matter of fact, this arrangement serves everybody well in the roaming network and is considered to be one of the major features of Internet roaming. That is, the user receives a single bill, the home ISP retains its own users and the local ISP will not concern itself with payment once the user is authenticated by the home ISP. Given the fact that the home ISP has already had a billing system in place for ordinary customer billing, the addition of Internet roaming would not create a new requirement for the home ISP. Integration of the roaming transaction records into the existing billing system is the key and the only work the home ISP needs to do to be able to bill its customers for Internet roaming service. The home ISP may elect to rely on the detailed transaction reports from the central clearinghouse agent as the basis for generating its own customer billing. Although this may not be a desirable alternative, it nonetheless illustrates how little the home ISP needs to do in order to offer global Internet roaming service to its customers.

5. BUSINESS ISSUES AND SOLUTIONS

Global Internet roaming can be accomplished in a variety of ways. Among the most common are the traditional way as that in international telecommunications services, i.e., peer-to-peer relationships, and the membership way, i.e., Internet roaming consortia.

5.1 PEER-TO-PEER RELATIONSHIPS

In the peer-to-peer relationship model, an ISP works with another or a group of other ISPs on an individual basis in order to expend its network coverage and to offer Internet roaming service to its customers through the network of the other ISPs. This arrangement would work fine if the number of ISPs were small. However, unlike the telecommunications industry where a few very large companies dominate the markets and the entry barrier into the market is very high, the ISP market has been flooded with thousands of companies, large and small. Since it is especially true that Internet roaming is more attractive to small ISPs than to big ones because it serves to expend the network coverage, any Internet roaming network tends to have a large number of (small) ISPs. Under such a circumstance, peer-to-peer relationship would be very difficult to establish and maintain. In addition, the global nature of the Internet roaming makes such a relationship even more difficult, especially for small ISPs. The nice feature of Internet roaming is that, once the network is established, the ISP would have a global network coverage or, more precisely, have a coverage in the area where it has a partner ISP.

5.2 INTERNET ROAMING CONSORTIA

Internet roaming consortium is a natural way of dealing with a large number of ISPs. It makes the management of the business relationships between ISPs much simpler. There is typically an independent enterprise or organization that owns the consortium, manages the network and serves the ISPs. ISP members of the consortium benefit each other. Once becoming a consortium member, an ISP immediately benefits itself in both ways. On one hand, the entire roaming network represented by the combination of all the member ISP networks becomes accessible to the ISP. That is, the ISP effectively expands its network to the size of the roaming network for access by its users. On the other hand, the ISP's network becomes accessible to all the other ISP members. That is, the ISP effectively expands its user base to the total number by all the ISPs in the roaming network. When a user of the ISP is in the local area where the ISP has POPs, the user will use the ISP's network to access the Internet. Whenever the user goes or travels to an area that is out of the network coverage of the ISP, the user will use a partner ISP's network to access the Internet, i.e., roaming. Similarly, a user of another partner ISP can use the ISP's network to access the Internet whenever the user is in the area that is covered by the ISP. The user is not prohibited from accessing the Internet through a particular ISP. It is always the economics and quality of network service that determines the favorite local ISP a user prefers to use. The reason for a user to access through a local

POP is to avoid paying for expensive long distance or international telephone charges. The sharing of network resources among ISPs in an Internet roaming consortium achieves the objectives of providing users with low cost Internet access and, at the same time, generating additional revenues for themselves. Therefore, it is both a win for the users and a viable business for the ISPs.

The success and rapid growth of Internet roaming consortia demonstrate the usefulness of the service and the wide acceptance of the concept. Since the concept is easy to understand and the service is easy to use, it is really the market and economics that define the limitation of the scope and the success of Internet roaming. On the economics side, as long as the rate of Internet roaming compares favorably to that of long distance and international telephone calls, it will exist as a valuable and competitive service for global Internet access. Currently, due to the monopoly situation in the telecommunications market in most countries, especially in the Asia Pacific region, the cost of Internet roaming to the users is substantially lower than long distance and international telephone calls. For example, most ISPs offer global Internet roaming service to their customers at the prices ranging from $4.00 to $24.00 in U.S. dollars per hour, depending on the region, which comes down to $0.07 to $0.40 in U.S. dollars per minute. Compared with most domestic long distance and international telephone calls, the rate is substantially lower. As the result of privatization effort underway in a lot of countries, telephone rate may gradually go down and the gap between the Internet roaming and direct phone call may be narrowing. That will gradually reduce the competitiveness and attractiveness of Internet roaming and, eventually, certain users may decide not to use roaming. Nevertheless, under such a circumstance, Internet roaming will still remain as a viable alternative for global Internet access.

6. IMPACT TO THE ASIA PACIFIC REGION

Global Internet roaming has generated a lot of enthusiasm in the Asia Pacific region, especially during the last eighteen months. This can be demonstrated by the large number of major ISPs, including the telco-based ISPs, that have joined one or more global Internet roaming consortium and offer Internet roaming service to their customers. This new development has primarily been the result of a favorable economic situation in the region, which results in frequent business travels within and out of the region. Since most business travelers have to stay connected to the Internet while on the road as a part of normal business, Internet access becomes a necessity rather than a luxury to them. Therefore, Internet roaming is very appealing to them because it is usually cheaper than dialing international long distance to directly connect to their home ISPs.

Current Internet roaming has covered all major countries in the Asia Pacific region such as U.S., Japan, China, Australia, Korea, Hong Kong, Singapore, etc. Together with the network coverage in Europe, other countries in the North and South Americas and even in parts of Africa, Internet roaming has really achieved the status as a useful mechanism for users to gain global Internet access with single user accounts. Another interesting observation of Internet roaming in the Asia Pacific region is that a number of major ISPs have participated in global Internet roaming and offered the service to their customers. Updated lists of the major ISPs can be obtained by visiting the home pages of GRIC (http://www.gric.com/) and iPASS Alliance (http://www.ipass.com/), two leading global Internet consortia in the world.

7. CONCLUSIONS

There has been a tremendous growth during the last eighteen months on global Internet roaming. However, the implementation of Internet roaming involves not only technical issues but also financial and business issues. In this paper, we discussed most of the outstanding issues and the various alternatives that make global Internet roaming a commercially viable solution for global Internet access. The impact of global Internet roaming to the Asia Pacific region was also examined to illustrate the popularity and acceptance of Internet roaming in the region. The increases in the use and in the number of users of the Internet together with the economics that Internet roaming offers will undoubtedly drive the global Internet roaming traffic to a substantially higher level in the near future to come. The market share of Internet roaming in the global Internet access business will only be determined by the difference in rates between Internet roaming offered by ISPs and long distance and international calls offered by telecommunications companies.

How Developing Countries will Profit from GMPCS

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Introduction

PTTs, regulators, investors and consumers around the world are closely watching the continuing progress of Global Mobile Personal Communications by Satellite (GMPCS), which promises to radically advance basic telecommunications services through the developing world.

The wait will not be long. Beginning in 1998, several Low-Earth orbit (LEO) and Medium-Earth orbit (MEO) satellite-based communi-cations systems will compete to provide digital voice, data, fax and position location services to users in every town, village and island.

Satellite technology arrives at a critical juncture for developing countries. In order to quickly expand telecommunications services into rural areas, the existing communications network and additional facilities must be extended to rural regions of very low telephone density. But deployment of wirelines and switching facilities imposes heavy financial burden and requires a significant investment of time for developing countries.

Under these circumstances, financing and deploying the telecommunications infrastructure to the rural areas of developing countries pose major challenges for most of these countries. In many parts of the developing world and for many applications, the demand for basic communications can only be met through mobile satellite services offered by GMPCS companies.

Is There Really a Difference Between All These Satellite Companies?

While the essential concept of a satellite telecommunications system is the same from system to system—calls get routed up from the ground to one or more satellites and then back down to the ground again--GMPCS comes in several different flavors (see Figure 1).

GEO Systems

Geosynchronous (GEO) satellites are those that reside 35,000 Km above the equator, and orbit the earth every 24 hours, allowing them to remain stationary above one fixed point on earth.

Currently, the only global GEO mobile communications satellite system available today is INMARSAT. The primary advantage to INMARSAT's system is that it *is* available today; however, the bulky, heavy, expensive phone (the size of a small suitcase, costs around $3k), and propagation delays inherent to GEOs make the newer GMPCS systems more attractive. To be sure, after 15 years of operation, INMARSAT still has fewer than 50,000 customers.

Current and planned regional GEO satellite systems include Australia's Optus MobileSat and Telstra MiniSat, AMSC in the United States, TMI in Canada and ACeS in the Asia Pacific region. While these newer GEO systems have taken advantage of the technological advances in the power of satellite antennas, allowing for smaller and

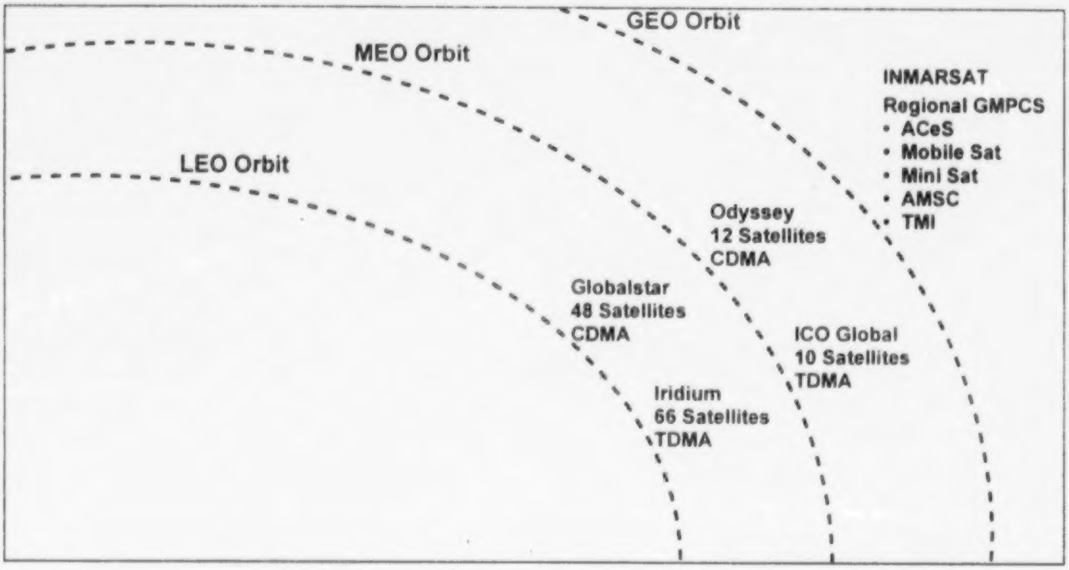

Figure 1. GEO, MEO and LEO constellations.

lighter portable phones, these systems all suffer from two major disadvantages—first, most are regional rather than global. Take these phones out of range of the GEO footprint and they become useless. Secondly, they cannot escape the propagation delays inherent in GEO satellites. However, for users who rarely stray far from home—essentially, those from many developing countries—these regional systems may be very attractive.

MEO Systems

MEOs, or Medium-Earth Orbit, satellites orbit the earth at approximately 16,000 km from the earth's surface. The two GMPCS systems falling into the MEO category include ICO, owned partly by INMARSAT, and TRW/Teleglobe's Odyssey. Because they are technically similar, these two systems are often lumped together with Globalstar and Iridium as "Big LEOs." ICO plans on a 10-satellite TDMA system, while Odyssey will rely on 12 satellites and will utilize CDMA.

These faster-orbiting, lighter weight MEO satellites allow for less expensive hardware and service than the GEOs, but their distance from the earth still causes slight voice delays. In addition, ICO has yet to receive FCC approval to operate in the United States, primarily due to 1) the FCC's objection to the relationship between ICO's investors—many of them national PTTs—and the signatories of Inmarsat, and 2) the as-yet unbounded relocation costs of compensating existing users of the 2 GHz band that ICO plans to utilize. On the funding front, Comsat, in explanation of its decision to abandon its direct equity position in ICO, recently announced that ICO system costs were increasing from $2.7 billion to $4.7 billion. Odyssey has received only bare-bones funding to date. However, despite these stumbling blocks and the fact that neither ICO nor Odyssey will be available until after the turn of the century, both are expected to be strong competitors in the GMPCS market.

Big LEO Systems

Orbiting between 500 and 1,400 km above the earth, Low-Earth Orbit (LEO) MSS systems offer another choice to potential MSS users. The two primary competitors in this arena include Iridium and Globalstar. Another company, Teledesic, backed by Microsoft's Bill Gates and former McCaw Cellular CEO Craig McCaw, is also a LEO system, but Teledesic's positioning as primarily a wideband, high data rate Internet access service place it in a different market than Globalstar and Iridium.

Iridium, backed by Motorola, is the most expensive of all the MSS systems at $5 billion in total system costs and quoted rates of $3,000 handsets and $3-a-minute airtime. Indeed, Iridium executives have stated publicly that their primary market will be international business travelers who can afford these costs, rather than rural users. Iridium plans a TDMA-based 66-satellite constel-lation that will pass calls from satellite to satellite; therefore, most of its technology is in space. As such, upgrading the technology may be extremely expensive, if not impossible. In addition, local PTTs without gateways could lose out on potential revenue. However, Iridium was first to launch in May 1997, has declared its intention to be first to market and is backed by the well-known global telecom-munications entity Motorola, making it a major force in the GMPCS market.

Globalstar is the only CDMA-based LEO system in the market. Globalstar plans a 48-satellite constellation whose satellites will act as simple "bent pipe" receivers, passing calls from one gateway to a reflective satellite and then back down to the user. CDMA allows Globalstar to operate with higher spectrum efficiency and greater signal quality. Moreover, the extensive use of worldwide gateways, permitting individual countries to share in Globalstar's revenues, has led to over 100 agreements with potential service providers around the world. Globalstar plans to begin providing service in late 1998.

Projected GMPCS Market

How many users are all of these systems competing for? Estimates place the total addressable market at close to 30 million. Currently, over 3 billion people lack basic phone service and, according to the ITU, nearly 50 million people are on registered waiting lists for phone service.

In addition, international consul-tants KPMG Peat Marwick did a study that found that 60% of the population will not be covered by cellular by the year 2000, due to the prohibitive costs of creating a wireless network in areas of low population density and inhospitable geography/ topography.

Clearly, the telecommunications market requires a new system that will allow these millions of people, particularly in developing areas, to communicate with the rest of the world. Cellular and wireline networks will continue being built, but will not be available until well after the turn of the century. If developing nations are to keep advancing into the political, economical and social spheres populated by industrialized nations, they will need before then a reliable, cost-effective means of communicating. Right now, GMPCS is a good solution.

Costs vs. Benefits of GMPCS for Developing Countries

Much attention has been paid to the sexy side of GMPCS: mobile applications. GMPCS brochures are filled with photos of international business executives on the move, phoning the office from China, faxing from the Australian outback, getting paged in an African village. Indeed, GMPCS will deliver on these promises and the international business community will reap the rewards of this new technology. But what about developing nations, for whom fixed services will play the bigger role? How will they benefit from GMPCS?

As mentioned in the section entitled "Projected GMPCS Market," the need for reliable communications in developing nations is overwhelming. To compete effectively in the increasingly global economy, developing nations must commit to supporting this need. GMPCS provides these countries with several benefits:

- ***GMPCS is Coming Soon***. GMPCS will be available in the next few years, as opposed to cellular and wireline networks, which will take decades and billions of dollars. Developing countries don't have the luxury of waiting, nor do they possess the capital necessary to invest in these other networks. GMPCS will allow developing nations to catch up dramatically to industrialized nations by fostering communication, trade, and, ultimately, wealth.

- ***GMPCS Provides Reliable, Consistent Service***. Existing telecommunications networks in developing countries are notorious for limited availability and poor voice quality. GMPCS service solves these problems through state-of-the-art digital technology that eliminates echo (with the exception of GEO-based systems), provides increased capacity and improves availability.

- ***GMPCS Increases Investment Opportunities for Developing Countries***. While the business plans of the various GMPCS companies differ, all have recognized that joint ventures with local investors of developing countries are the key to success. Both Globalstar and Iridium, the front runners of the Big LEO companies, have secured agreements with over 100 countries each by joint venturing with investors who have a vested interest in making sure their territory is successful.

- ***GMPCS Increases Revenue Opportunities for Developing Countries***. Again, GMPCS companies have chosen different ways to address how developing countries will receive revenue from their systems, but among them are sharing call revenue, tail charges, roaming charges, handset distribution, and ground station maintenance.

- ***GMPCS will Bring Jobs for Local Residents***. As more and more people purchase fixed and mobile products, GMPCS operators will need to employ local residents who have the skills necessary to work with potential customers in the marketing, business and technical arenas. Ground stations will require maintenance, and service providers will need a network of repair people, technical support workers, and salespeople to keep their customer base satisfied.

Clearly, GMPCS offers a reliable telecommunications network, invest-ment and job opportunities, and a piece of the revenues to developing countries. Yet in the recent World Telecommunications Policy Forum held last October in Geneva, developing countries expressed a number of concerns about GMPCS.

The primary concern was that GMPCS operators would siphon off traffic from the existing telecommunications networks. In fact, the share of a developing nation's revenue will depend on the GMPCS operator. With Globalstar, for instance, all calls that originate or terminate in the developing country will pass through the local ground station, and a certain percentage of that call's charges will go to the PTT. Globalstar service providfers expect to build 70-80 ground stations, or gateways, around the world to ensure that local PTTs are not cut out of the action. Other GMPCS operators will also have a small number of ground stations throughout the world that will provide for revenue-sharing. It is critical for developing nations to study the business plan of each GMPCS operator to ensure that it is compatible with their own goals.

It is also critical for industrial nations to continue to recognize and accommodate the requests of developing nations. For example, at the WTPF, industrialized nations did make a concession in the area of revenue sharing by agreeing to share traffic data with developing nations. The compromise was later incorporated into the MoU regarding mobile satellite phone terminal circulation.

Another issue that affects developing countries is political. For example, nations that are politically blacklisted by the United States government (such as Iran, North Korea, and Cuba) are concerned that the U.S. view of them as politically undesirable could lead to a service cutoff, restrictions on the number of circuits or other trouble in getting equal treatment from the satellite operators (three of the four Big LEO operators are U.S.-based). They want assurances that this will not happen, and that they will get nondiscriminatory access to the systems.

A U.S. government official at the conference stated that while the United States government will never relinquish its rights to cut off communications or use other sanctions involving any global systems, it rarely exercises them in connection with telecommunications systems and is highly unlikely to do so with satellites.

Moreover, as a show of good faith toward these countries, GMPCS operator Iridium has made arrangements to allow Iran to buy shares in its system which will be licensed there by setting up an offshore company in Bermuda to handle its government ownership program and other financially related matters.

Ultimately, developing countries are most concerned about the systems' costs. GMPCS operators are very aware of the fact that they will not be able to utilize the same pricing structure for the fixed market that they do for the mobile market. Mobile calls that cost anywhere from $1 to over $3 a minute are simply not affordable to cash-strapped residents of rural areas and developing nations. So what is the solution?

GMPCS companies are currently examining several options for establishing an equitable fixed services pricing policy. These options include subsidizing fixed service with the revenues from mobile services, although this option will not work in countries whose fixed services far outweigh mobile services. Operators are also hoping that the governments of these developing nations will consider an initial subsidy of fixed traffic or equipment, although any subsidy would be minor. In addition, local service providers may offer special rates at certain times of day, as many of the long distance carriers do.

Clearly, this is an area that GMPCS operators need to consider more in-depth, since the fixed services market will be essential to their profitability.

Bridge the "Missing Link"

In 1984, under the leadership of Sir Donald Maitland, the Independent Commission for Worldwide Tele-communications Development issued "The Missing Link" report. This report pointed out that developing countries, which accounted for 70 percent of the world population and 20 percent of the gross domestic product (GDP), possessed only 7 percent of the world's telephones. This disparity is even more marked in low-income developing countries where telephone systems was restricted to the urban areas, and beyond those areas there is no system at all. No substantial progress has taken place since the report.

GMPCS operators must uphold the vision of bridging this "Missing Link" and allowing this 70 percent of the world's population to receive basic telecommunications services that will upgrade the efficiency of their economic, commercial and administrative activities and, more importantly, improve their daily lives.

Bangladesh Ventures for Cellular Mobile Phone Service To Access Village People

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ABSTRACT

This is the story of the challenges being made for providing basic telephone service to its teeming rural population by one of the poorest countries in the world. Time and again Bangladesh managed survival during the natural calamities. It developed and introduced the concept of Micro Credit without any collateral to combat poverty for the poorest of the poor. Now it ventures to provide access to telephone service to its rural population with Cellular Telephones!

1. Rural poverty is one of the most vexatious issues for the developing countries anywhere and its alleviation gets top priority in the agenda of development. Bangladesh occupy a special position in this field, because 7.2% of the world's poor live in Bangladesh. With a per capita annual income of US$ 240 and a population density of about 820 per sq. km, Bangladesh has a telephone density of less than 4 telephones per 1000 population. 80% of its people lives in the rural areas, where there are less than 3 telephones per 10000 population. It has a scanty infrastructure and is frequented by natural calamities like floods and cyclones too often. However, it has shown the world time and again how to manage the survival during the natural calamities and save its population from dreadful diseases like Cholera and Diarrhea by developing simple solutions like administration of Oral Saline. From here two of the most successful models of rural poverty reduction emerged. It has developed and introduced the concept of Micro Credit without any collateral to combat poverty for the poorest of the poor. It has also developed a Non-formal Education and Empowerment of destitute rural woman. This is the story of the challenges now being made for providing basic telephone service to its teeming rural population by one of the poorest countries in the world. Bangladesh ventures to provide access to telephone service to its teeming rural population with mobile cellular telephones!

2. A pervasive feature in the rural areas of Bangladesh, is lack of or very poor access to basic infrastructure, basic social and human services, and poor prospect of welfare improvements and growth. For city dwellers with their illusions of superiority complex, conceiving any technological breakthrough in the village is nothing but fantasy. Yet it is the village that sustains the city with its produce and human resource. A well functioning telecommunication infrastructure and a good transport system in the village shall allow division of labor and increase employment opportunities in the rural areas. Lesser costs in the rural areas shall increase competitiveness. The

Billing of Village Pay Phone

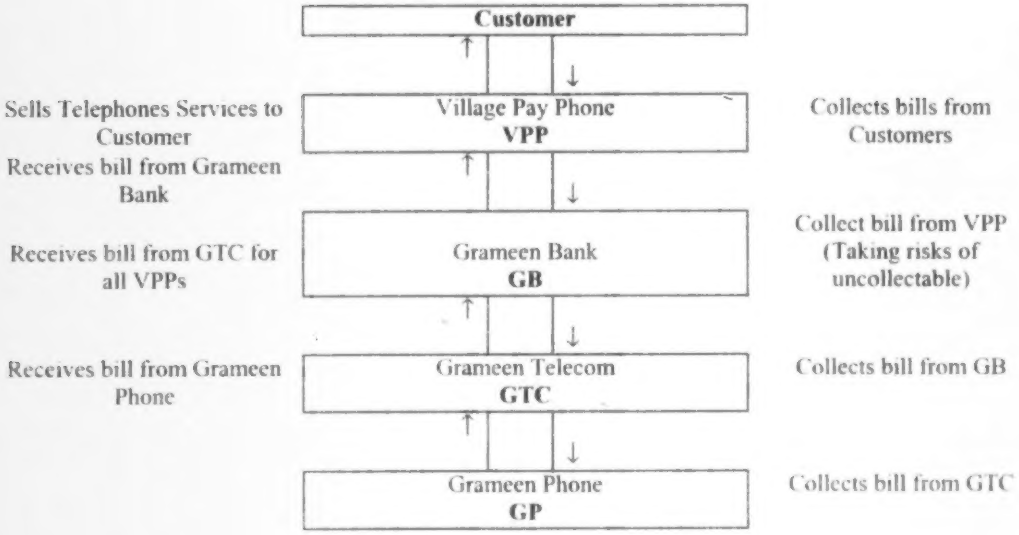
Customer
Sells Telephones Services to Customer
Receives bill from Grameen Bank
Village Pay Phone
VPP
Collects bills from Customers
Receives bill from GTC for all VPPs
Grameen Bank
GB
Collect bill from VPP (Taking risks of uncollectable)
Receives bill from Grameen Phone
Grameen Telecom
GTC
Collects bill from GB
Grameen Phone
GP
Collects bill from GTC

Figure 1. Flow Diagram of Billing System

Figure 2. Children from village talking with Father working in city.

Distribution of Village Pay Phone Earnings

Customer Pay	Tk. 4.50 per minute
VPP Operator Keeps	Tk. 1.90 per minute
Grameen Bank Keeps	Tk. 0.18 per minute
Grameen Telecom Keeps	Tk. 0.12 per minute
Value Added Tax (VAT)	Tk. 0.30 per minute
Grameen Phone Gets	Tk. 2.00 per minute

1 US $ = Bangladesh Taka (Tk.) 45

Revenue from Village Pay Phones during first three months

	Name of VPP Operator	Telephone No.	Revenue in 1st Bill	Revenue in 2nd Bill	Revenue in 3rd Bill	Total
1	Laily Begum	17510000	15314.71	10167.92	8341.67	33824.30
2	Renu Akhter	17510001	3711.31	2989.49	1455.12	8155.92
3	Nurjahan Begum	17510002	8845.11	10897.74	4374.35	24117.20
4	Parul Hossain	17510003	1697.21	1875.89	964.53	4537.63
5	Anwara Khatun	17510004	3156.46	1862.66	1116.13	6135.25
6	Jahura Begum	17510005	2065.49	1172.90	909.59	4147.98
7	Jothsna Begum	17510006	2710.52	8407.83	2301.82	13420.17
8	Tahmina Yasmin	17510007	3055.45	1619.18	968.45	5643.08
9	Sufia Begum	17510008	3584.96	14382.50	12273.45	30240.91
10	Rina Akhter	17510009	2990.19	1778.44	740.72	5509.35
11	Foratunnessa	17510010	2945.19	11959.82	7350.41	22255.42
12	Chhaaya	17510011	226.57	1444.85	2479.47	4150.89
13	Sheuly	17510012		2339.62	2004.32	4343.94
14	Shukurbi	17510014		2274.32	21571.39	23845.71
	Total		**50303.17**	**73173.16**	**66851.42**	**190327.75**

Average monthly bill paid to GP from each VPP	Tk 4010.28
Average GTC earning per month from each VPP	Tk.208.53
Average GB earning per month from each VPP	Tk.312.80
Average total bill paid (monthly) by each VPP	Tk.4531.61

1st Bill - From 14/4/97 to 11/6/97
2nd Bill - Upto 20/7/97
3rd Bill - Upto 20/8/97

* These earnings do not include the income by VPP Operators through Tips that she/he gets from the customers for rendering service for Incoming Calls. The earnings from Tips for incoming calls from abroad in particular are substantial.

linkage effect of telecommunications will facilitate inflow of required information speedily. Good telecommunication facilities will diminish the distance from decision-centers, will increase the amount of accessible information, will support the availability of services and training and will help to establish the missing link to distant firms and markets.

3. The idea of introduction of cellular phones to the village, especially to its women, is one of the most ingenious notions in the history of rural development. It may be questioned, " What can be these village people do with mobile cellular phones anyway?" To put it simply the "village people" are using the phones to make money. Bangladesh has not only come up with the innovative approach of giving villagers the access to information in order to generate income but has also brought the city closer to the village and vice versa.

4. Many people residing in the cities regard cellular phones as one of the most glamorous progeny of modern technology. It was the ultimate status symbol, especially for a man, to possess a mobile phone. Now the game is reversed. In the rural areas of Bangladesh, it is now the woman who possesses the cellular handset, and it is the phone call that is of greater significance than the ownership of the phone.

5. Telecommunication is a highly cost intensive industry. To get an economic return on the investment, a high Telecom traffic per telephone is required to generate the necessary revenue. But the normal traffic from individual subscriber in villages is too meager to justify its economic viability. Therefore, concentration of telephone traffic of a group of people to a specific telephone to act as a mobile Village Pay Phone has been ensured. The mobility of the Pay Phone ensures adequate coverage of the telephone service to the village population. The Operation and Maintenance costs of these telephones have been kept at a minimum level by involving local people to maximum extent.

6. People living in a rural area, do not generally have enough financial means to pay for the Cellular Handsets. Modus operandi to finance the Cellular Handsets by the rural banking institutions to the village people, who normally have little or no spare capital to invest, has been addressed.

7. A village woman, chosen by the people living in the area, receives a loan to finance the Cellular Handset. She resells the telephone service to the people of the village with a small premium and clears the telephone bill as well as pays back the loan on weekly basis.

8. Under the system, the Village Cellular Service Provider purchases bulk Air-time from the Commercial Cellular Operator. The Village Cellular Service Provider leases one handset in one village to a qualified Village Cooperative Bank member (who is normally a women) of that village at a fixed charge with fixed rates for incoming and outgoing calls. In houses where there is no electricity, the Village Cellular Telephone Service Provider installs a solar panel for recharging the batteries. The member is trained to use that phone and extends the services to customers for both incoming and outgoing calls. That is

she (or he) becomes the Village Pay Phone Operator. The phone call service is her enterprise, and she earns the difference between the fixed charges paid to Village Cellular Telephone Service Provider and the amount charged to the customer for the call. The Village Cellular Telephone Service Provider fix the rates the Operator charges her customers and monitor her business activities, so the customers are assured that she is not getting undue advantages of her new asset. Further, if she defaults her payment to the Bank, she loses her status as the Village Operator. As the Operator takes the payment in advance, there is also little scope for the customer to take advantage of the situation. In village everybody knows the other villagers. There is a lot of trust among the villagers, and words travel quickly. There is hardly any chance of theft of the handset, or harassment of the Operator.

9. The mobile phones are reducing the cost of living in the villages while increasing the purchasing power of those places. This will lead to greater volumes of trade that will benefit the country as a whole. The exposure to modern technology will also remove the fear of technology. The greatest social benefit is that cellular phones will give villagers the incentive to be literate. It will happen naturally with the exposure to technology. Further, the implementation of the telephone services will ensure progress in practically every aspect of the life of the villagers.

10. As a result, the overall perspective in the rural community is changing drastically. No longer the rural people have the feeling of being isolated. It is now possible for a son working in the capital city of Bangladesh to contact his bed ridden sick mother in the village, as the mobile pay phone can reach her easily. A farmer is able to get information regarding prevailing price of his produce and can take appropriate marketing decision. There has been burst of economic activities and the village community have become alive.

Figure 3. Incoming Call from Husband working abroad

Acknowledgement / Reference

Subject	Source
1. The Information Infrastructure Meeting the Need of Bangladesh.	Fazlur Rahman PTC'96
2. Bridging The Information Gap	Star Magazine, Dhaka, Bangladesh. June 6, 1997
3. GRAMTEL ----A Vision for Rural Bangladesh	Fazlur Rahman APT Telecom Journal Jan 1998.
4 Grameen Bank	Dhaka, Bangladesh
5. Grameen Telecom	Dhaka, Bangladesh

Development of a Delivery System for Multimedia Instruction over the Internet: The Adaptive Multimedia Education Enabler (AMEE)

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1. ABSTRACT

The Adaptive Multimedia Education Enabler (AMEE) suite of applications provides value added enhancements to the Internet. AMEE is designed to provide an easy to use interface to multimedia courses which are delivered at a distance. The operation of AMEE is effectively transparent to the user, being an extension of the World Wide Web browser paradigm.

2. INTRODUCTION

The Internet has been used as a medium for providing distance education for decades. With the emergence of the World Wide Web with multimedia delivery capabilities, the number of courses designed for delivery over the Internet and the bandwidth requirements for each course has grown exponentially. Unfortunately, the kind of bandwidth necessary to deliver, for example, video on demand, is not widely available, particularly in rural areas and in developing countries.

The Adaptive Multimedia Education Enabler (AMEE) project (1) was conceived to address the rising demand for accredited courses which are ubiquitously accessible electronically. This ambitious, 15 month project brought together stakeholders from ten consortium partners in the fields of education, computing science, engineering and human resources (2). This document outlines the goals of the consortium, presents the implementation, and then examines the effectiveness of those efforts in reference to the goals.

The adoption of the Internet as a communication and information exchange tool, has presented an opportunity for educators to change non-interactive distance education to a multifaceted, multimedia rich system. Unfortunately, not all institutions, schools and learners are connected to the Internet although there is growing pressure for schools to be connected. For example, the Alberta government provided a grant of $5 million to assist schools in connecting to the Internet by June 1, 1997. This grant provides $2,750 for each school site and for the jurisdiction office site to obtain "basic Internet service" which was defined as 28.8 Kbps Internet connection with WWW, FTP and e-mail service (Alberta Education, 1996). "It is apparent that the United States government and major U.S. Universities intend to be inter-connected at very fast speeds by the year 1999. Other parts of the world, including the Asia Pacific economies and Canada, have similar plans for connectivity at speeds up to 1,000 times faster than what is possible today. This advance will be helpful in addressing the connectivity needs of major institutions. A greater challenge, is to bring the benefits of technology-based education to people who need it all over the world." (Keenan, 1997) It is highly unlikely that in a country as sparsely populated as Canada, or in many of the developing countries of South East Asia, that high speed connections (e.g., cable modems, fibre optics or wireless service) will be ubiquitously available in the near future, rather, traditional telephone connection (possibly including ISDN service) over twisted pair wires will be the available technology of the masses.

3. PURPOSE

The purpose of the AMEE project was to develop a family of products that would move us significantly closer to open, easy to use, and integrated access to distance learning opportunities regardless of "last mile" network technology.

This goal can be further broken down into the following requirements:

- a simple, effective interface for learners and educators using computers for distance education;
- an interface product that can be adapted for any size of network; with
- a network product that will enable access to print, video, audio, text and multimedia learning tools;
- scheduled delivery of those tools to learners regardless of the computer technology used at the learner's end and "last mile" communications technology.

4. PROJECT COORDINATION & MANAGEMENT

The AMEE project involved ten institutions located throughout the Province of Alberta, and over 45 people. As lead contractor, TELUS provided a project manager who coordinated the work of two project teams: the

Education Team and the Technical Team. Members of both teams were separated by regional and institutional boundaries. The Technical Team leader worked for ISA Corp., located in Calgary. The project's chief systems developer and his development team were also located in Calgary, but the other half of the technical development team was located at the University of Alberta in Edmonton. Similarly the Education Team leadership was distributed between the University of Alberta and the University of Calgary. The entire process was overseen by two senior researchers, one each from Universities of Alberta and Calgary. Table 1 identifies the leadership/management roles of the project personnel.

Most of the day to day coordination and communication of the project was handled electronically. E-mail between individuals, mailing lists for broadcasting information, an FTP site for the storing of documents, specifications, etc. and a Web site (http://amee.com) provided effective communications between members of the teams. The AMEE web site was also used to share information with the public. Various presentations were posted for viewing and details about the AMEE project and the AMEE Frequently Asked Questions were presented.

The most important links that the site provided were the links to the Course Calendar and to the CACs (Community Access Centres) that were involved in the field trial. In a very short time the AMEE Web site became the entry point for information on the AMEE project or for access to the AMEE Field Trial.

5. REQUIREMENTS FOR DISTANCE LEARNING AS SPECIFIED BY THE EDUCATION TEAM

The Education Team put forth the following key requirements crucial to distance learning and teaching:

- identify the kinds of courses which can be delivered,
- identify course providers to write and/or deliver the courses,
- provide a user friendly interface,
- provide on-line registration specific to each institution,
- provide the opportunity for students to browse the inventory of course offerings,
- schedule & track students' activities,
- provide trouble shooting on technical and academic issues, and
- deliver as much material as possible through electronic means.

Table 1: Location and Roles of Project Manager, Senior Researchers and Coordinators

Title	Located at	Roles
Project Manager	TELUS	• primary administrator • primary contact for legal negotiations, communications with CANARIE • budget coordination
Senior Researchers	University of Alberta and University of Calgary	• provide "vision" • oversee the entire project
Education Team Coordinator	University of Alberta	• worked closely with the technical team coordinator to ensure the desires of the education team were met • act as a liaison between the diverse educational community and the technical team • act as a facilitator, delegated duties and passed information to the rest of the team • relayed the project direction to all project participants
Technical Team Coordinator	The ISA Corporation	• worked closely with the programmers responsible for writing the code and developing the system • worked with the network provider to establish the network for the field trial
Chief Systems Developer	Alberta Research Council	• designed/implemented technical specifications • oversaw the programming team

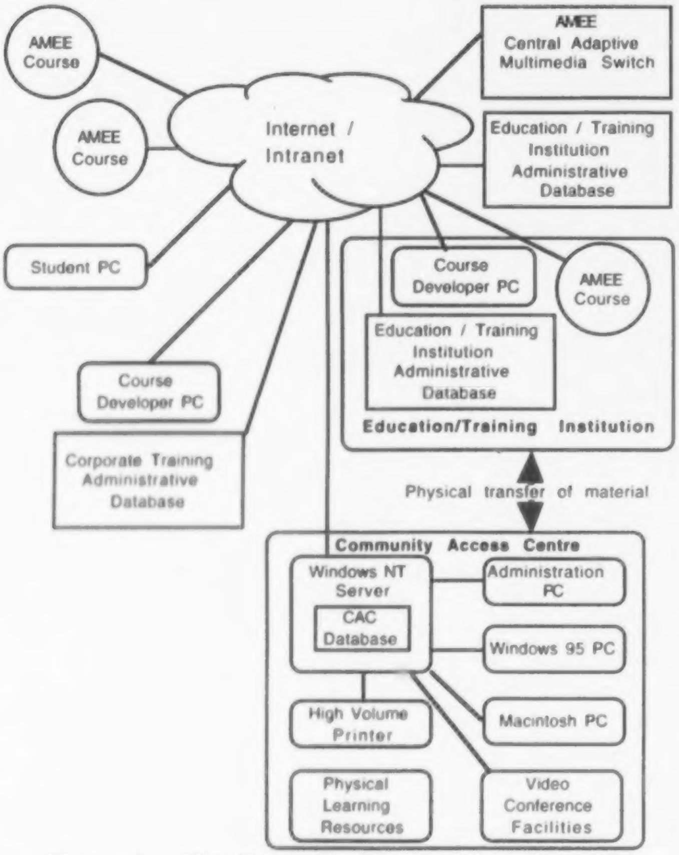
AMEE Course
AMEE Course
Internet / Intranet
AMEE Central Adaptive Multimedia Switch
Education / Training Institution Administrative Database
Student PC
Course Developer PC
AMEE Course
Education / Training Institution Administrative Database
Education/Training Institution
Course Developer PC
Corporate Training Administrative Database
Physical transfer of material
Community Access Centre
Windows NT Server
CAC Database
Administration PC
Windows 95 PC
Macintosh PC
High Volume Printer
Physical Learning Resources
Video Conference Facilities

Figure 1 - The Education Team's View of AMEE

These requirements led to the design of a family of products designed to provide distance learners with the ability to access a wide variety of instructional materials across heterogeneous communications systems. Figure 1 provides a pictorial overview of AMEE as developed by the Education Team.

Three different groups of users were identified:

5.1 THE INDIVIDUAL LEARNER

The Individual Learner User Interface was specified to provide a common, integrated front end to both existing and newly created tools. The individual user would be able to:

- browse available courses (open access),
- apply for a student ID,
- apply to register in a course,
- specify preferred delivery mode,
- specify configuration of delivery site,
- download course modules,
- have optional control of NTSC video output to attached VCR for staged video download where insufficient disk space is available to store the entire sequence,
- have optional control of audio output to attached audio recording device for staged audio download where insufficient disk space is available to store the entire sequence,
- exchange e-mail,
- access class computer mediated interaction,
- download / upload assignments, and
- utilize desktop video conferencing.

5.2 THE COURSE PROVIDER

The Course Provider User Interface, similar in design to the Individual Learner User Interface, would allow the course provider to:

- specify course structure and timing,
- utilize templates from previous courses,
- distribute updates,
- identify supplementary material,

- identify demand availability vs. scheduled availability,
- set up class computer mediated interaction,
- review / modify class registration,
- distribute, collect and grade assignments,
- send / receive e-mail, AND
- utilize desktop video conferencing.

5.3 THE COMMUNITY ACCESS CENTRE

The Community Access Center User Interface WOULD provide mainly administrative tasks:

- set up and manage learner accounts,
- track CAC AMEE usage and provide local billing information,
- create hard copy, video tape, audio tape, etc. for pick up by students,
- manage local storage space, and
- schedule usage of local facilities and equipment.

6. DESIGN AND IMPLEMENTATION - THE TECHNICAL TEAM'S TASK

The Technical Team had the task of trying to implement the changing and at times unclear specifications provided by the Education Team while working in an environment of constantly changing technology. The architectural model of the AMEE framework comprises of five layers illustrated in Figure 2.

6.1 DESIGN OVERVIEW

6.1.1 USER APPLICATIONS/INTERFACE

The User Applications/Interface layer consists of: 1) the Content Provider User Interface, 2) the Community Access Centre Tool Set, and 3) the Learner User Interface (see Figure 2).

The Content Provider User Interface was implemented in Java (version 1.0.1). When downloaded via a web browser, it connects with the Content Manager (Centra 2000) via CGI (Common Gateway Interface) programs to retrieve, edit, create, and organize course content. The design of this interface is based upon a file manager paradigm as exemplified by Microsoft® Windows™ 3.1 File Manager and Sun's® File Manager (Solaris 2.x™).

The CAC Tool Set provides administrative tools to manage users, physical resources, and scheduling of physical resources. The information is maintained in a Microsoft Access 7.0™ database. The tools are implemented as a set of web pages with access to the database provided by CGI programs using ODBC connections.

The Learner User Interface consists of a set of web pages which permit the learner to schedule (reserve) physical resources, to enroll in courses, to drop courses, and to provide links to enrolled courses and conferencing.

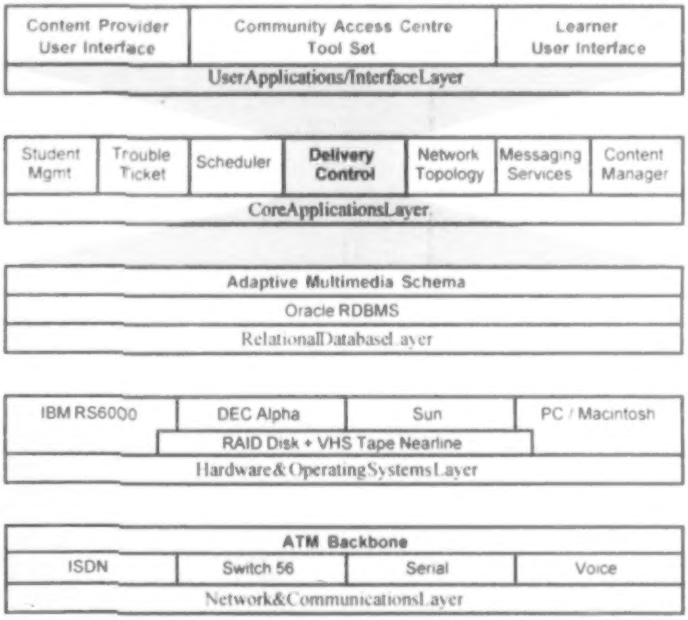
Content Provider User Interface
Community Access Centre Tool Set
Learner User Interface
UserApplications/InterfaceLayer
Student Mgmt
Trouble Ticket
Scheduler
Delivery Control
Network Topology
Messaging Services
Content Manager
CoreApplicationsLayer
Adaptive Multimedia Schema
Oracle RDBMS
RelationalDatabaseLayer
IBM RS6000
DEC Alpha
Sun
PC / Macintosh
RAID Disk + VHS Tape Nearline
Hardware&OperatingSystemsLayer
ATM Backbone
ISDN
Switch 56
Serial
Voice
Network&CommunicationsLayer

Figure 2 - AMEE Logical Design Overview

Data used by this interface is stored in the MS Access™ database and functionality is provided via CGI programs using ODBC connections.

6.1.2 CORE APPLICATIONS SOFTWARE

This layer consists of: 1) Student Management, 2) Scheduler, 3) Delivery Control, 4) Network Topology, 5) Content Manager, 6) Messaging Services, and 7) Trouble Ticket. The Scheduler, Student Management, Delivery Control, and Network Topology are implemented as a set of cooperating daemons. A new function implemented by the "Gateway" daemon provides a single point of access from clients, the CACs, to the other daemons; and enables secure access to the AMS. Another daemon called "Database" provides information to clients, where such information is not provided by any of the other daemons. The daemons are written in the C programming language and typically use embedded SQL queries to the Oracle database. These queries are written in PRO*C.

Student Management is responsible for registration of new students. It provides a unique id number for each student, thus providing an institution independent registration system. This module also provides the capability for students to enroll in, or to drop a course.

The Scheduler manages schedules for each student. A student has a schedule for each course he/she is taking. When a student accesses his/her schedule, it is uploaded to the CAC, modified by the student, and then downloaded to the AMS. Any modifications may cause the Scheduler to notify the Delivery Control and Network Topology modules which may in turn initiate actions of their own.

The Delivery Control module is responsible for shipping course content to the CAC and/or student. Content which is purely electronic is queued for later delivery via FTP. For physical materials such as video tapes, or CD-ROMs, an e-mail message is sent to an AMS administrator; this e-mail notifies the administrator what content needs to be sent (mailed, couriered, etc.) to where or to whom.

The Network Topology module allocates and controls bandwidth for the secure and reliable delivery of course material. It does this by creating a shipment for the course content that needs to be sent and then tries to find a suitable time for the shipment. If it fails, it recommends the earliest available time. If successful, the shipment is handed over to the Delivery Control system. The Content Manager functionality is provided by Centra™ 2000 which is a document management system which resides on top of an Oracle database.

Messaging Services consist of both e-mail and conferencing systems. The e-mail is provided by an IMAP4 e-mail server running on the AMS. E-mail accounts for each student are created and students access their e-mail via a Simeon™ client. Conferencing is provided by the Virtual U system at the University of Alberta.

Trouble Ticket was implemented through a set of Unix trouble reporting procedures.

6.1.3 RELATIONAL DATABASE

The AMEE Technical Team designed the central repository based on an open standard in order to avoid having the end product committed to a proprietary product whose closed architecture might hinder the purchasing decisions of potential customers. The relational database used was an Oracle 7™ system. This database is also used by the Content Manager. The AMS database schema consists of additional tables which were created and populated with relevant information. Access to these tables by the AMS daemons is via embedded SQL programs written in PRO*C™ and gathered together into a program library.

6.1.4 HARDWARE

Hardware and operating system requirements can be categorized into three different configurations: the AMS and Application Server configuration, the CAC Server configuration, and two different CAC node configurations.

The AMS consists of two machines. The Oracle database, content manager, and the AMS daemons reside on a SPARC™ 5 running SunOS 4.1.3™. The AMEE web site, the IMAP4 e-mail server, and the content are located on a SPARC 10 running Solaris 2.4. In addition to the AMS hardware, application servers were made available to distribute the load of supporting applications, such as video conferencing. Table 2 provides a summary of the minimum hardware configurations required.

6.1.5 SOFTWARE

Software was either purchased commercially or developed by the Technical team. Table 3 identifies the applications installed on their respective platforms and the feature that each application provided.

6.1.6 NETWORK & COMMUNICATIONS

AMEE was conceived out of a need to better service the long distance education market. With the advent of multimedia products and information rich content, the current bandwidth and accessibility limitations presented interesting network challenges.

Although the specifications called for an Intranet as the network infrastructure for the AMEE field trial, the latest

Table 2 - AMEE Minimum Hardware Configurations

Configuration	*Hardware Specification*	*Purpose*
1. AMS Server	• Sun SPARC 10+, 64Mb to 128Mb. • 4 mm Tape backup. • 12xCD ROM • 5G SCSI disk. • 2-Network Interface Cards. • High Quality 21" Monitor.	The AMS Server is the central repository, registration, authentication and data server. Such services require ample disk space 5G+ and significant processing speed since it could potentially serving all of the students within the AMEE network. All of these services need not reside on one machine.
2. Application Server	• SPARC or Intel® Platform 166MHz • 32Mb RAM • 2.1 -5G Storage. • 17" Monitor • Backup Device • Multiprocessing O/S.® Unix or Windows NT.	Video Servers, Web and E-mail Servers, Computer conferencing servers.
3. CAC Server	• Pentium Processor 150MHz or above • 64 Mb RAM • 12xCD player • 2 GB SCSI disk + 1GB SCSI per attached desktop • Network Interface Cards (NIC) • Laser Quality Printer • 16 bit sound card • High Quality graphics monitor, 17" • 0/S - Windows NT or higher.	Server is the gateway through which the students access the AMEE network. All requests initiated out of the CAC must be routed through this server. The server houses the client software as well as the indigenous information for the respective institution.
4. CAC Node		
a) PC-Intel Based	• Pentium 133MHz • 16-32MB RAM • 2 GB IDE or SCSI • 16 bit Sound Card, Speakers optional • NIC or Ethernet Card • 12xCD Player • 17' monitor • Windows 95/NT™	The CAC nodes act as the access points for the CAC students. Some courses will have special requirements such as computer or video conferencing, subsequently the node will be equipped with the corresponding hardware and software.
b) Apple Macintosh	• Macintosh 7500-8500 • 17" Multisync monitor • 16 bit Sound Card, Speakers optional • NIC or Ethernet Card • 16 MB of RAM • 12xCD Player • System 7 or higher Mac OS.	Apple uses their own proprietary network protocol (Apple Talk), however there are third party applications that allow PC's to mount Macintosh files and vice versa. Note: because of the translation layer there was significant administration overhead.

advances in technology would more appropriately define the network as an *Extranet*. The network team, which designed and administered the AMEE Network, faced many challenges, not the least of which was defining an open standard for both the hardware and the Internet Protocol. Faced with six different sites, each with their own standards, network specifications and communication requirements, the network team was able to implement what may be the first large scale Extranet in western Canada. The different connection types included ATM to routers, ATM directly to the back of CAC PCs, multiplexed switch 56 lines to routers, and multiplexed ISDN BRI channels to routers. Figure 3 shows the AMEE logical network diagram.

Table 3 - Minimum Software Requirements

Platform	***Software Application***	***Purpose***
1. AMS Server	• Oracle 7 RDBMS • AMEE, AMS server software. • DNS/NIS services • HTTP Services	Backoffice repository for AMEE administration and content. Application Access. Name Services for access and authentication. Web Services
2. Application Server	• Video Server Software • Computer Conferencing Software • IMAP4 E-mail Server	Course required, software. Course required software.
3. CAC Server	• AMEE CAC web site installation software • Microsoft Office with Microsoft Access • Netscape Navigator 2.1 • Analysis tools, (i.e., Big Brother) • E-mail client software • ODBC driver pack ver. 3.	Access to the AMEE Network. Central Application used by the CAC Nodes. Used for administration and trouble shooting For trouble shooting. Communication Software Interface to the AMS repository.
4. CAC Node a) PC-Intel Based	• Netscape Navigator 2.1 or greater (Must be Java Enabled browser). Various plugins both commercial and freeware for viewing multimedia content. • Microsoft Office 95™ or most current • Course specific software such as Photoshop™ • E-mail client	AMEE interface tool for content. Office automation software either loaded locally or shared on a network drive. Self explanatory. Either loaded local or on a network Drive.
b) Apple Macintosh	• Same as above.	Same as above.

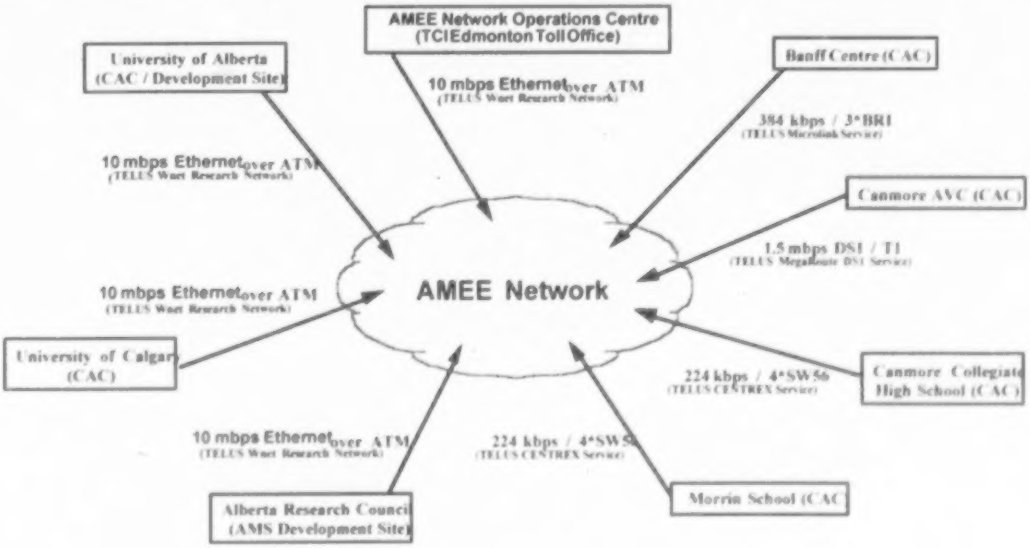
AMEE Network Operations Centre
(TCIEdmonton TollOffice)
University of Alberta
(CAC / Development Site
Banff Centre (CAC)
10 mbps Ethernet over ATM
(TELUS Wort Research Network)
384 kbps / 3*BRI
(TELUS Microlink Service)
10 mbps Ethernet over ATM
(TELUS Wort Research Network)
Canmore AVC (CAC)
1.5 mbps DS1 / T1
(TELUS MegaRoute DS1 Service)
AMEE Network
10 mbps Ethernet over ATM
(TELUS Wort Research Network)
University of Calgar
(CAC)
224 kbps / 4*SW56
(TELUS CENTREX Service)
Canmore Collegiat
High School (CAC)
10 mbps Ethernet over ATM
(TELUS Wort Research Network)
224 kbps / 4*SW5
(TELUS CENTREX Service)
Alberta Research Counci
(AMS Development Site
Morrin School (CAC

Figure 3 - AMEE Logical Network Overview

6.2 IMPLEMENTATION PROCESS

6.2.1 ADAPTIVE MULTIMEDIA SWITCH

A major requirement for AMEE was the ability to schedule then deliver course content to the student. The development of the core applications; student management, scheduler, delivery control, network topology and the creation of the AMS database schema (Figure 4) became the primary focus in order to fulfill this requirement.

Initially, there were two independent design and implementation efforts. The first was the development of the Content Provider User Interface. The second was the development of the Scheduler. The development process consisted of a series of design, code, and test phases.

For the AMS, individuals were assigned to specific implementation tasks:

- Scheduler and Student Management,
- Database Schema and database access routines,
- Topology Manager and Content Provider,
- Shipper, and
- Course content management and implementation of secure access to courses.

Fundamental integration tests of the AMS and CAC were performed by the team as a whole and a functioning AMS was demonstrated to a CANARIE representative by Dec. 15, 1996.

6.2.2 COMMUNITY ACCESS CENTRE

No formal process was established for the development of the CAC client application. Code and feature reviews were conducted by the Technical Team, and status reports were produced. However, the lack of sufficient communication between the two Technical Teams resulted in a divergence of interpretations of the requirements.

The CAC team consisted of a Educational Advisor, Module Team Leader and two programmers. The construction of the community access center utilized Java, CGI Programming, and HTML. The interfaces required the Netscape APIs and ODBC in order to communicate with the browser and the local database, respectively.

The CAC application was sub-divided into the following segments and features.

User interfaces:

- Generic CAC Home page
- AMEE Home Page
- CAC Account creation
- Program/course listing
- Course Enrollment Process
- Payment Process
- Student Course portfolio management
- Student Course scheduling (Integrated with CAC schedule)
- Taking a lesson
- Change to another CAC

CAC Administration Interfaces

- Manage client accounts
- Update CAC's asset management calendar
- Financial management

The CAC features and modules were constructed according to the functional process depicted in Figure 5.

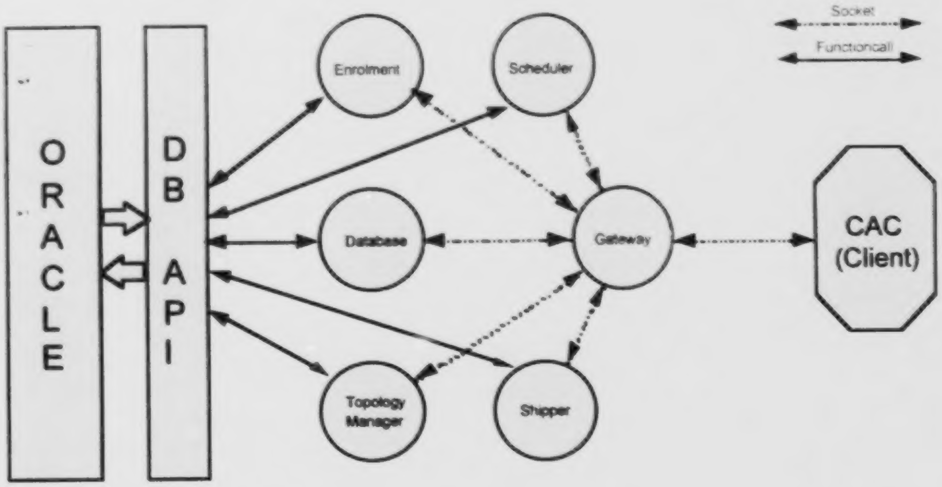

Figure 4 - AMS Implementation Architecture.

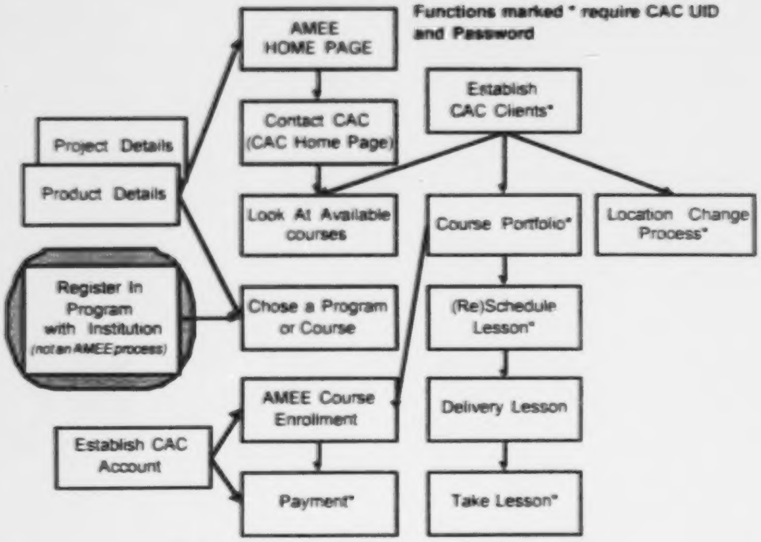
Functions marked * require CAC UID and Password
AMEE HOME PAGE
Contact CAC (CAC Home Page)
Look At Available courses
Chose a Program or Course
AMEE Course Enrollment
Payment*
Establish CAC Clients*
Course Portfolio*
Location Change Process*
(Re)Schedule Lesson*
Delivery Lesson
Take Lesson*
Project Details
Product Details
Register In Program with Institution (not an AMEE process)
Establish CAC Account

Figure 5 - CAC Functional Process

The CAC interface teams iterated throughout the design, build, test development cycle, producing a prototype in August of 1996, and the alpha version of the production software in January of 1997.

The assumption that each CAC could provide a technical resource to install and administer the internal CAC LAN proved to be a mistake. Many of the administrators were ill prepared to handle the nuances of installing and configuring the operating system and CAC applications. It is not feasible to specify a minimum level of technical administrative competence for the CAC administrators. Subsequently a significant effort was made to provide centralized technical support including hardware setup, application support and network support.

6.2.3 NETWORK

Two independent but related sub-tasks were defined for the implementation of the AMEE network. The first was the configuration and system setup of the individual CAC LANs and the second was CAC/AMS connectivity. TELUS provided connectivity to the demarcation point (i.e., the telephone patch panel at which the communication line entered the CAC's building) of the CAC. When it became evident that some CAC's were unable to connect their internal networks to the demarcation point, TELUS offered to configure their routers and help each CAC connect the router to the internal CAC LAN. This is an important observation since many Internet customers are faced with the same challenges.

In the process of building the AMEE network three phases were required in order to ensure CAC connectivity (defined as the ability to communicate with the AMS):

- CAC LAN Connectivity - establish network connectivity with in the CAC's local area network.
- CAC Point of Presence - establishing connectivity between the routers of each of the CAC's, and
- Point to Point Connectivity - establishing connectivity between all of the AMEE nodes.

During the project, the Class C Internet address was transferred to TELUS. At the same time, a decision was made to move the network from the TELUS PLAnet service to the TELUS Advanced Communications service. The two changes resulted in delays and introduced a new set of problems.

Because the CAC LANs were computer labs within the respective institutions, the allocation of the network equipment and computers fell under the policies and capital asset structure of the individual institutions. Figure 6, the detailed diagram of the AMEE Extranet, shows that the implementation of the AMEE network was no simple task. Incorporating the requirements of the project with the network policies of the respective institutions served to compound the problems of building an Extranet.

Once the network was operable, tests were conducted to evaluate connectivity and performance. The connectivity was measured through actual participation in the field trial. As each CAC received their respective hardware and configured their servers and routers a *point of presence* was established for each site. Connectivity to the CAC LAN was then tested.

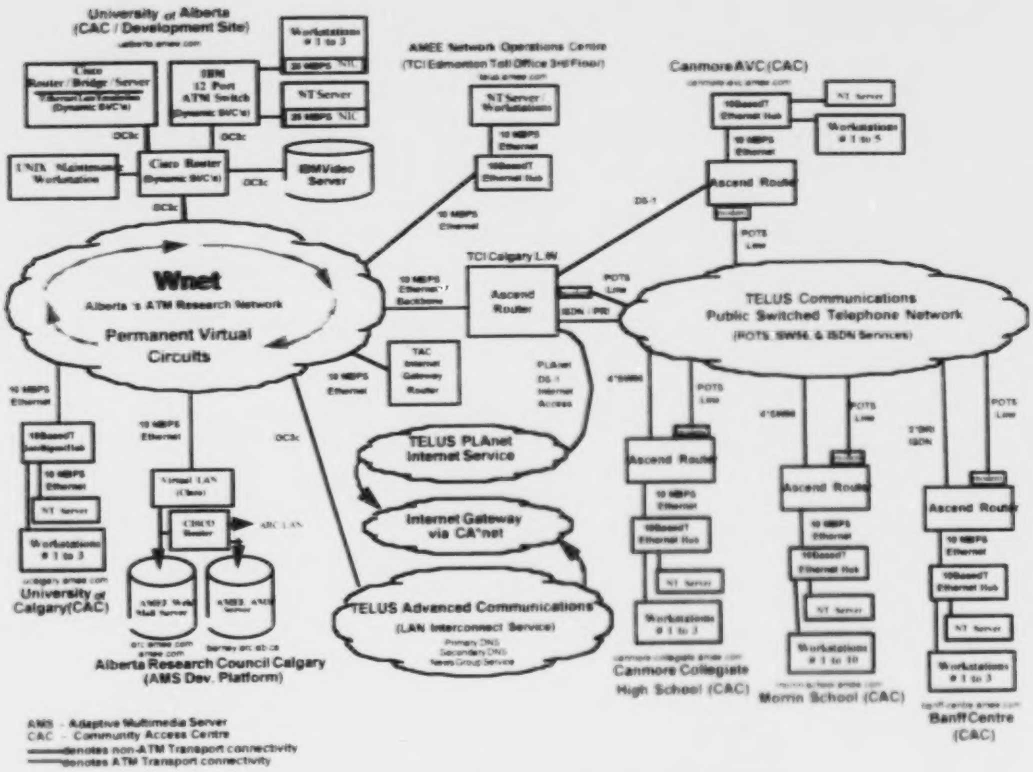
University of Alberta
(CAC / Development Site)
Workstations # 1 to 3
25 MBPS NIC
Cisco Router / Bridge / Server
(Dynamic SVC's)
IBM 12 Port ATM Switch
(Dynamic SVC's)
NT Server
25 MBPS NIC
OC3c
UNIX Maintenance Workstation
Cisco Router (Dynamic SVC's)
IBM Video Server
AMEE Network Operations Centre
(TCI Edmonton Toll Office 3rd Floor)
NT Server / Workstations
10 MBPS Ethernet
10BaseT Ethernet Hub
Canmore AVC (CAC)
NT Server
Workstations # 1 to 5
Ascend Router
DS-1
POTS Line
TCI Calgary L.W
Ascend Router
ISDN / PRI
Wnet
Alberta 's ATM Research Network
Permanent Virtual Circuits
10 MBPS Ethernet / Backbone
TAC Internet Gateway Router
PLAnet DS-1 Internet Access
TELUS Communications
Public Switched Telephone Network
(POTS, SW56, & ISDN Services)
4*SW56
3*BRI ISDN
TELUS PLAnet Internet Service
Internet Gateway via CA*net
TELUS Advanced Communications
(LAN Interconnect Service)
Primary DNS
Secondary DNS
News Group Service
10BaseT Ethernet Hub
Workstations # 1 to 3
University of Calgary(CAC)
Virtual LAN (Cisco)
CISCO Router
ARC LAN
Alberta Research Council Calgary
(AMS Dev. Platform)
Canmore Collegiate High School (CAC)
Workstations # 1 to 10
Morrin School (CAC)
Banff Centre (CAC)
AMS - Adaptive Multimedia Server
CAC - Community Access Centre
denotes non-ATM Transport connectivity
denotes ATM Transport connectivity

Figure 6 AMEE Intranet Infrastructure Detail

the network) was established for that site. Connectivity to the CAC LAN was then tested.

CAC network protocols were as varied as the members of the consortium, ranging from NetBeui to AppleTalk. Since AMEE content was delivered across the Internet the standard had to conform to the Internet Protocol. In addition, the TCP/IP packets ran across:

- Asynchronous Transfer Mode (10Mbps Channel),
- Integrated Synchronous Digital Network (ISDN, 3 Multiplexed BRI Lines, for a total of 384Kbps),
- 56Kbps switched data lines, and
- DS1/T1 (1.5Mbps).

In order to transmit TCP/IP packets across the ATM lines, TELUS subscribed to the Encapsulation Standard, RFC 1483.

7. THE FIELD TRIAL

Ensuring that AMEE met functional specifications did not, however, adequately test whether "the right product" had been produced. The field trial with learners taking courses in a real world setting was the true test. It was essential that the AMEE product family be able to simultaneously serve the needs of a number of distinct groups of learners: K-12 learners, post secondary students, adult learners, and business training.

The field trial sites were selected to test the utility of the system in delivering course material to different physical locations with different levels of access. The Banff Centre, University of Alberta and the University of Calgary were set up as high-level access centres; AVC Calgary, Morrin School and Canmore Collegiate were set up as low-to-medium level access centres. The Field Trial began on January 27, 1997.

7.1 AUDIENCE AND CONTENT:

The primary client was defined as an adult learner, including people from all aspects of society who wished to pursue life long learning. These learners, for the most part, had limited experience with distributed learning.

The on-line AMEE course calendar was the primary information source for courses offered through the AMEE project. All pamphlets or handouts made reference to this on-line calendar. Community Access Centres used both internal institutional promotion (word of mouth instructor recommendation, etc.) and external promotion (distance education advertising, etc.).

7.2 REGISTRATION

Learners were required to satisfy the registration requirements of their CAC. The AMEE system was designed to channel students into the registration process. A disclaimer statement informed students of the nature of the research and gave them the right to opt out. Those students who chose to opt out were allowed to participate in the AMEE delivery of material, but were excluded from research reports.

All cancellations and withdrawals were handled by each institution in their normal fashion. Students were given specific dates to withdraw from the course with a full, partial, or no refund. The withdrawal dates were considerably more flexible for this particular Field Trial. Normal fees were collected by the institutions, but no additional fee was charged for use of the CAC or the AMEE technology.

7.3 COURSE SUPPORT

Support personnel were generally existing system administrators or other computer lab personnel. AMEE support personnel were required to handle all technical aspect of running and supporting an instructional computer lab. Extensive experience with both PC and Macintosh systems was required. In addition, support personnel were required to maintain the lab network which required experience with Windows NT.

The AMEE Educational team in conjunction with the Technical team drafted standard operating procedures (SOPs) for the delivery and administration of AMEE courses. Levels of support included FAQs, Help Forms (response from lab personnel or instructor with 24 hours), the Conferencing System (response from other students); peer support, and e-mail system.

7.4 IMPLEMENTATION

The field trial had been planned to run from January 4, 1997 to April 30, 1997 but a number of organizational, technical and personnel considerations combined to delay the start of the field trial. Extreme pressure caused the Field Trial to begin on January 27 even though some of the technology had not yet been implemented (e.g. the e-mail system). This caused students and CAC administrators severe problems.

7.5 EVALUATION

The evaluation was designed to allow decision makers to decide between three options: a) to continue using AMEE in secondary and post-secondary education without modification; b) to continue using AMEE as an educational tool with modification; c) to discontinue the use of AMEE in education. The field trial and evaluation (Kirek & Chugh, 1997) of AMEE was guided by three questions:

1. How do learners perceive AMEE's effectiveness?
2. How do course authors/providers perceive AMEE's effectiveness?
3. How do CAC staff perceive AMEE's effectiveness?

"Effectiveness is often but not necessarily used to refer to the conclusion of goal achievement evaluation, with all its limitations. Success is roughly equivalent to this sense. Effectiveness can be construed more generally as referring to achieving an outcome ...it always refers to a goal,... It is a means and end notion" (Scriven, 1991 p. 129) (3).

Three different populations were invited to take part in the study: learners/students (terms student and learner are used interchangeably), course authors/providers and CAC administrators. Three distinct instruments were used to collect attitudinal, experience with the computer, and demographic data from each type of user. Data were collected by means of both on-line questionnaires and telephone structured interviews. Frequency distributions were computed on closed questions whereas content analysis was conducted on open-ended responses.

7.5.1 EVALUATION FINDINGS/SYNTHESIS

All three groups of AMEE users considered flexibility its main strength. Because of the flexibility and the promise of integrated access to distance learning opportunities, the learners and providers agreed that AMEE may improve educational transactions. But "educational technology is more than the sum of the individual processes and hardware. It provides the knowledge and means to extend and enhance learning through communication" (Garrison, 1989, p. 49). Theoretically, educational transaction, supported by two-way communication, is based upon three crucial factors: a) seeking understanding and knowledge through dialogue and debate; b) there is no place for coercion and manipulation; and c) education must be able to support explanatory feedback (Garrison, 1989).

A majority (70%) of the learners and half (50%) of the course providers felt that AMEE would improve the educational transaction and 70% of learners felt technology should be incorporated in the framework of learning. Paradoxically, AMEE's technology was seen as both it's strength and it's weakness. Users reported varying degrees of frustration with some of the commercial components that AMEE utilized. Notably, e-mail capabilities and computer conferencing failed the users regularly.

Some users missed the classroom type interaction: 55% of the learners and 34% of the course providers felt a loss of interaction. Some users specifically felt the loss of face-to-face interaction with their instructor and peers.

Overall, 65% of learners, 83% of course providers and 60% of CAC administrators were pleased with the services provided by this trial; 80% of the learners said they would enroll in courses delivered through AMEE in the future; and 83% of the course providers said they would develop and deliver courses through AMEE.

The evaluators, however, felt that AMEE was only moderately effective in this trial. Users had a range of both technological and administrative problems. Users provided a spectrum of suggestions to refine and improve AMEE, including: improve the technology, incorporate face-to-face component, make AMEE more flexible ("walk the talk"), improve educational transaction/interaction, improve accessibility and administration, and conduct on-going evaluation to determine progress.

Given that the field trial was implemented before the technology was completely in place, the developers were extremely pleased with the results of the evaluation. Changes to the system which incorporate the suggestions of the evaluators are under review.

8. CONCLUSIONS

The general purpose of the AMEE project was to answer two core questions: (1) Can educational content be effectively distributed across the Internet? and (2) Will there be a demand for this service? As the project comes to a close the answer to the first of these questions is a resounding, YES!! The answer to the second question is "Yes -- but how can we recover the cost of implementing this technology." The challenge now is to leverage this body of research into a viable commercial product that can fulfill that demand. The members of the consortium are presently discussing how they should proceed with AMEE. In this vein, the following recommendations are made:

- A modified AMEE project should continue.
- Contracts should be negotiated with a few beta-sites.
- Features that have either been deferred or missed from the AMS should be prioritized and implemented.
- Rewrite the CAC software to utilize push technology and zero administration operating systems.
- Develop financial models to examine the cost/benefit of using AMEE.
- Modify the AMEE interface to interact directly with common Post-secondary registration systems.

In summary, the development and implementation of the AMEE technology can be considered a success. The technology worked. Some areas where improvements are necessary have been identified, and a preliminary evaluation suggests that these improvements can be implemented without unreasonable costs being incurred. Finally and most importantly, students and course developers generally supported the use of the technology. AMEE is a technology that will allow distance learners who do not have high bandwidth access to the Internet to engage in courses which are rich in multimedia and interactivity.

9. NOTES

1. The AMEE project was seeded by a $1.8 million (Canadian) grant from CANARIE Inc.
2. The AMEE consortium was led by TELUS, Corp., a the third largest telephone company in Canada. Partners included the Alberta Research Council, Alberta Vocational College (Calgary), Banff Centre for the Arts, Canmore Collegiate High School, High Performance Computing Corporation, Integrated Systems Application Corporation (ISA Corp.), Morrin School, the University of Alberta, and the University of Calgary.
3. The evaluators did not determine the efficiency of the AMEE development. "Efficiency goes beyond effectiveness by bringing in a reference to the amount of resources involved. It implies the absence of wastage from inputs to outputs. To that end efficiency question(s) measures wastage (or lack of it) from the input to the outputs" (Scriven, 1991 p. 129).

10. REFERENCES

Alberta Education. Network Access Grant to School Jurisdictions. http://ednet.edc.gov.ab.ca/technology/tech_network_access.html, 1996.

Keenan, T.P. "Sharing Global Knowledge Through Technology-Based Distance Education." In proceedings of *APEC Tel HRD '97 International Symposium*, Beijing, China (1997).

Kirek, I & Chugh, U. Effectiveness of AMEE: Results of the AMEE Field Trial. University of Calgary. June, 1997

Garrison, D.R. *Understanding Distance Education: A Framework for the Future*. Routledge, New York, 1989

Scriven, M. *Evaluation Thesaurus (fourth edition)*. Sage Publication, Newbury Park, 1991.

Virtual-U, Virtual-U Research Project, http://virtual-u.cs.sfu.ca, 1997.

Interworking Between Telephone Network and Multimedia Communications Network

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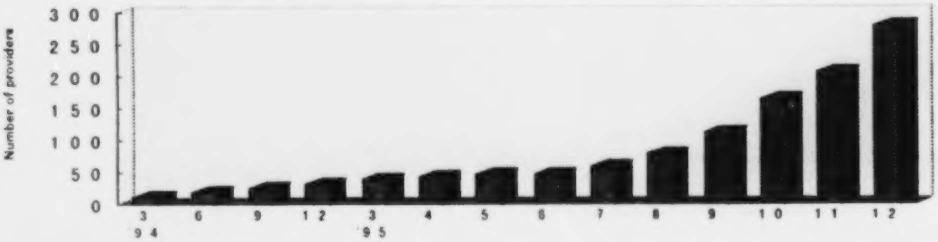
ABSTRACT

Rapid growth of the Internet and mobile communications networks shows a shape contrast to the nearly saturated telephone network in Japan. We analyze the features of these networks from the viewpoints of the communication time, expansion, representation of information and user age groups. Based on this analysis, we discuss the future interworking and development of these two types of communications. Identifying the network functions which are required to realize the near-future network, we propose a new network system configuration.

1. PREFACE

In recent years, mobile and Internet communications have grown explosively in Japan. The number of mobile communications subscribers has increased by more than 200% from 7 million as of the end of September 1995 to 24 million at the end of January 1997. As shown in Figure 1.1, the number of providers at the end of 1996 was nine times greater than that in the previous year. As of January 1997, there are reported to be more than 10 million Internet subscribers.



(Source: Reference materials from the Ministry of Posts and Telecommunications)
Note:
The above graph indicates the total number of registered class-1 and class-2 carriers providing the Internet services.

	1994				1995									
Year and month	3	6	9	12	3	4	5	6	7	8	9	10	11	12
Number of carriers	11	18	24	31	38	42	45	58	78	78	110	163	206	279

Figure 1.1 Growth in the number of Internet providers
(Source: 1996 White Paper on Communications)

Internet communications differ fundamentally from the existing communications systems and research is required to understand the background to its explosive growth. Studies are required to determine a direction for the future coexistence of the existing telephone communications and the Internet. Through this research and study, we must propose and construct a network system in the necessary direction.

This paper first clarifies the features of telephone and Internet communications from the viewpoints of communication time, expansion, representation of information, and user age groups. Then this paper discusses the direction for future fusion of the two types of communications. By considering the network services which will be necessary in the near future, we propose a network system configuration which will be able to realize these services efficiently.

2. COMPARISION OF TELEPHONE AND INTERNET COMMUNICATIONS

In Figure 2.1, telephone and Internet communications are classified by the forms of presentation of sent and received information and network services. This figure shows that freedom to select forms of presentation is allowing Internet communications to extend the scope of its coverage hand-in-hand with the development of personal computers.

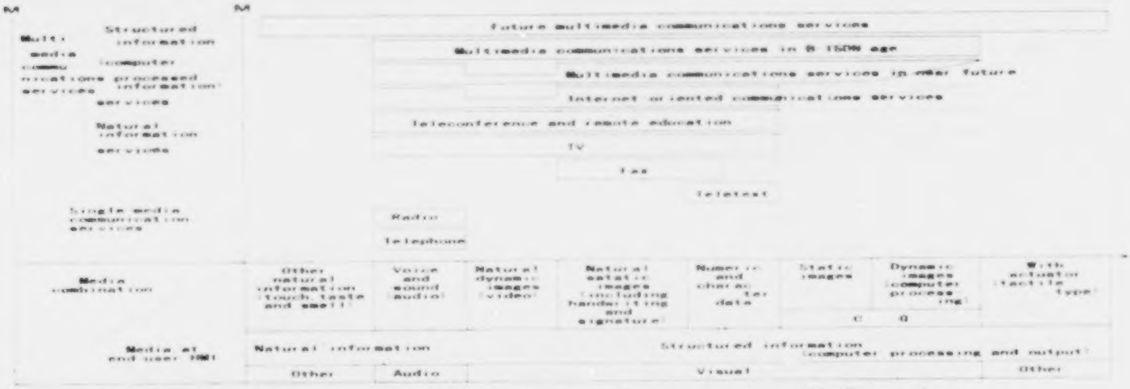
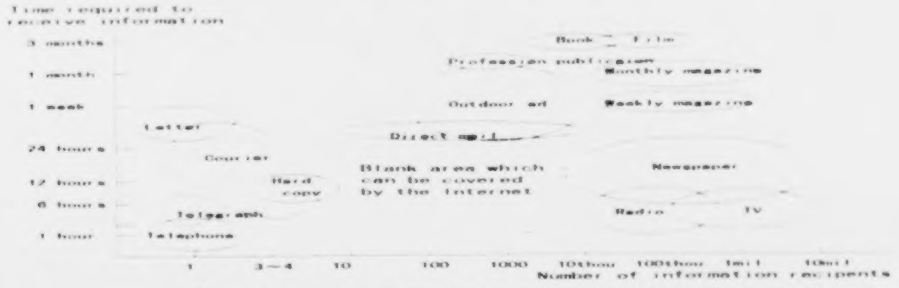

Multi-media communications services
Structured information (computer processed information) services
Natural information services
Single media communication services
Future multimedia communications services
Multimedia communications services in B-ISDN age
Multimedia communications services in near future
Internet oriented communications services
Teleconference and remote education
TV
Fax
Teletext
Radio
Telephone
Media combination
Other natural information (touch, taste and smell)
Voice and sound (audio)
Natural dynamic images (video)
Natural static images (including handwriting and signature)
Numeric and character data
Static images
Dynamic images (computer processing)
With actuator (tactile type)
Media at end user
Natural information
Structured information (computer processing and output)
Other
Audio
Visual
Other

Figure 2.1 Multidimensional range of media (forms of presentation of information)

"Media-blank areas" (Figure 2.2) suddenly came into focus when introduced in the 1978 White Paper on Communications of Japan. The Internet seems the best means of filling these blanks.



Source: "Local Information Communication Systems in the Age of New Media" (Teisin Bunkasha 1984) The original concept is based on the 1978 White Paper on Communications

Figure 2.2 Media-blank areas (Source: Networking Economics)

The quick downsizing of computer systems caused computer networks to change from the centralized to the distributed processing systems. Meanwhile, communications changed from a hierarchical network structure to a flat one (Table 2.1). With those changes, the popularity of Internet communications is growing.

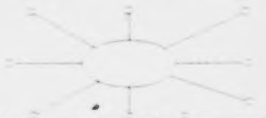
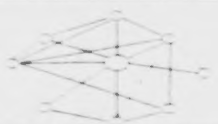
	Centralized processing	Distributed processing
Computer network	 ·Mainframe and dumb terminals ·Centralized ·Specialists required	 ·Interconnections of microcomputers ·Not centralized ·Specialists not required for daily operation
Telecom network	 ·POTS oriented ·Hierarchical ·Monopolistic ·CPE essential for network	Other network ·ISDN ·Not hierarchical ·Competition ·CPE separation ·Interconnections including LANs and private networks

Table 2.1 Centralized processing to distributed processing (Source: Networking Economics)

3. FUSION OF TELEPHONE AND INTERNET COMMUNICATIONS

With this tendency in communications, Internet communications, when realized in the existing communications network, will also be able to cover telephone communications. However, we should not jump to the conclusion that we should only think of constructing a network for Internet communications. Figure 3.1 shows the age groups of telephone and Internet users in Japan.

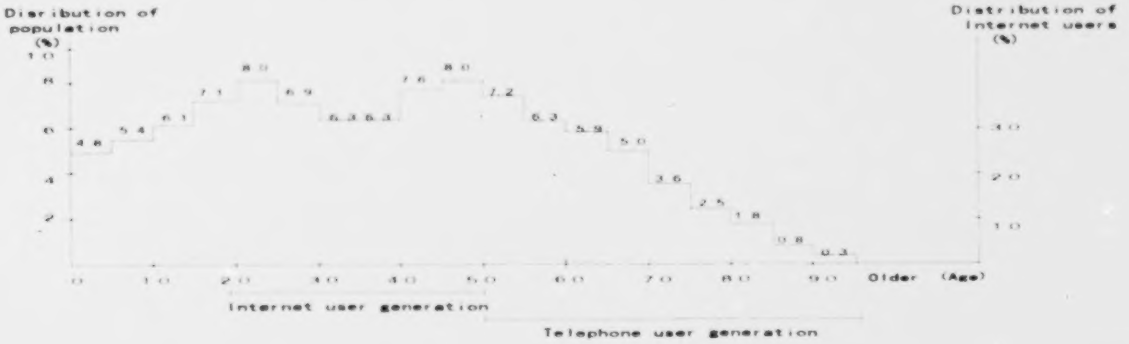


Figure 3.1 Age groups of telephone and Internet users in Japan
(Source: Sixth Study Meeting of Communications Software Engineering)

As the figure shows, most Internet users are in their 20s to 30s. People in their 50s and older, accounting for about half the telephone users, will probably not use the Internet. When we look at our parents in their 60s and 70s, they tend not to use machines with more than three function buttons. For many people in their 50s or older, the Internet is not exciting but nuisance. Function of terminals increasingly improve and become complicated while learning ability of the aged declines. This means they will continue to stick to telephone communications for about another 20 years. Once people now in their 40s reach their 60s, people in almost all age groups will feel no resistance to Internet, and telephone communications will be totally included in Internet communications.

For many users, telephones are communications terminals and personal computers are for Internet communications and they don't think of using the same terminal for both telephone and Internet communications. Telephone users expect a network to support the existing voice communications available anytime, anywhere, and with anybody. Internet users expect a network to support text and other non-voice communications even with those who do not subscribe to the Internet.

Ultimately, a network is expected to realize communications compatibility between telephone and the Internet with the functions listed in Table 3.1. In particular, telephone users expect to use the communications terminals like ordinary telephone terminals.

	Asynchronous communications service	Synchronous communications service	File transfer service	Information retrieval service
Telephone to Internet	Telephone to E-mail (to be realized by enhanced voice recognition technologies at the beginning of the 21st century in Japan)	Telephone and Internet phone (Already implemented by IDT of the United States as "NET2phone") Telephone and IRC Telephone and CU-SeeMe (Telephone and Internet for audio communications, pending for video communications)		(Based on representative **WWW**) Telephone and **WWW** See "Telephone and Internet phone" for vioce media. "Telephone to E-mail" or "E-mail to telephone" for text media and "Telephone and CU-SeeMe" for image media.
Internet to Telephone	E-mail to telephone (to be achieved by voice synthesis and storage) NetNews to telephone (already in service using voice answering equipment)			

Table 3.1 Compatibility between telephone and Internet communications
(Source: Sixth Study Meeting of Communications Software Engineering)

To realize mutual conversion between the different means of communications, a media conversion network is expected to develop in the future to enable smooth communication between the telephone network and Internet (Figure 3.2).

The media conversion network requires functions for voice recognition, synthesis, and storage. By linking these functions with the mailing and broadcasting functions of the Internet, different kinds of communications can be set up seamlessly between the telephone network and Internet.

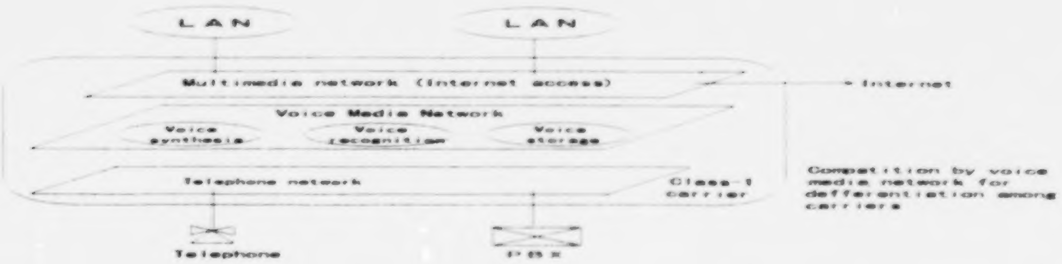


Figure 3.2 Network configuration at the beginning of the 21st century
(Source: Sixth Study Meeting of Communications Software Engineering)

4. CONFIGURATION OF MEDIA CONVERSION NETWORK

Before discussing the configuration of a media conversion network, we should consider the functions expected from the telephone network and Internet and compare them to determine the functions required from the media conversion network. Then we discuss the optimum network configuration to realize these functions.

Communications systems for a telephone network should satisfy the following requirements:

i) Realtime characteristics: switching telephone terminals always within 100 ms
ii) Ultra-multiplex processing: constant monitoring of 100,000 or more telephone terminals to connect requested terminals immediately
iii) High reliability: immediate recovery from faults to prevent system failure

To meet these requirements, systems have been built up from scratch by adding dedicated operating systems and dedicated application software to dedicated hardware.

Internet is expected to have a structure that satisfies the following requirements easily and immediately:

iv) Standard interface: open interface that enables communication with any party and allows user-created software to be used anywhere
v) Extensive range of packages: A great variety of hardware packages and software libraries that allows immediate realization of desired functions

Given the above, what functions should be required from a media conversion network between the telephone network and Internet?

All the requirements from i) to v) must be met by the media conversion network. Although difficult will it be to satisfy all these requirements and despite the potential risk of over–investment, it is necessary to fulfill these severe conditions in order to construct the intelligent communications system.

There is an argument that these requirements must be satisfied at the terminal level. However, no receiving Internet terminal can be ready 24 hours a day for communication (transmission) from a telephone terminal. Therefore, the network needs voice storage, voice conversion, and other voice service functions. This is why these services should be realized at the network level.

The following three methods of construction are available for creating a network system to satisfy the severe requirements i) to v):

1) System separation method:
This is a method to separate from existing switching systems that part of the functions which is determined to be more effectively developed as a general-purpose products and

to realize such part on a general-purpose machine.

This method is often used in intelligent networks (IN), home location registers (HLR) and intelligent peripheral (IP).

2) System-OS coexisting method:
This is a method to add general-purpose interfaces and OSs to existing switching systems and thereby to enable realization of general-purpose functions which is determined to be more effectively developed on a general-purpose machine. This method is adopted by some manufacturers of communications equipment.

3) General-purpose method:
This is a method to realize on a general-purpose machine the real-time processing, ultra-multiplex processing and high reliability, which are the requirements for switching systems, and thereby to make the general-purpose machine perform switching operations which have been done by switching systems.

This method has been common among data switching systems but has not been adopted by any manufacturer of communications equipment for telephone switching systems.

(See Figure 4.1 for details of the three methods.)

To select the optimum system construction methods for the media conversion network, advantages and disadvantages of the system construction methods are compared, as follows.

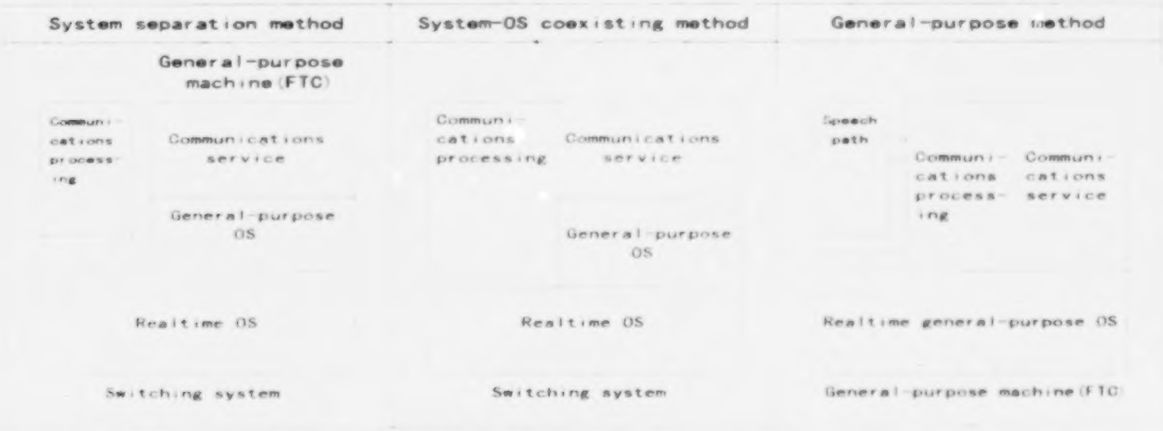

System separation method
System-OS coexisting method
General-purpose method
General-purpose machine (FTC)
Communi-cations process-ing
Communications service
General-purpose OS
Communi-cations processing
Communications service
General-purpose OS
Speech path
Communi-cations process-ing
Communi-cations service
Realtime OS
Realtime OS
Realtime general-purpose OS
Switching system
Switching system
General-purpose machine (FTC)

Figure 4.1 System configuration of the media conversion network

1) Features of the system separation method: This system construction method is suitable for quick construction of a large-scale communications network because functions can be added easily. However, the separation of functions from switching systems causes equipment investment and increase additional function processing, and system construction will not be able to keep up with the trend of downsizing (logic of mass). Therefore, this method can only be regarded as an intermediate solution.

2) Features of the system-OS coexisting method: This method is very effective for extending the life of an existing switching system but is still worse than the system separation method in terms of keeping up with the trend of downsizing. Considering the facts that it requires a lot of labor to port, maintain and manage general-purpose packages for each specialized (realtime) OS and that different manufacturers are creating and using their own OSs, this method is very risky .

3) Features of the general-purpose method: This method does away with the existing switching systems. This method is not popular because those who have long been engaged in the development of existing switching systems will lose their jobs. However, once the base functions of a switching system is constructed on a general-purpose machine, this method is far superior to the other two methods in terms of keeping up with the trend of downsizing and easiness of adding services. Disadvantages of this method are the low processing performance and instability common to initial general-purpose systems.

Among the above three methods, the general-purpose methods should be the best solution for efficient development of the basic system and quick addition of services, considering the easiness of construction of the development environment, the trend of downsizing, effective equipment investment and future system continuity. If the low processing performance and instability common to general-purpose systems can be overcome, this will be the main form of system construction in the future.

The recent advent of realtime UNIX and other high-speed OSs has enabled the high cost performance of a dedicated switching system to be realized by carefully considering the software configuration of the platform and application. High reliability is obtained on a fault tolerant computer (FTC) by adding reliable software functions to the platform to allow file replacement with uninterrupted system processing and instant software fault recovery.

However, processing performance of current general-purpose systems is still low, with the following potential problems:

a) System processing is interrupted for several hours when the OS (UNIX) files are replaced.
b) The system fails in case of an OS (UNIX) panic.
c) The system is often stopped when the hardware (CPU and I/O bus) needs to be expanded.

These problems cannot be ignored in telephone and other mission-critical systems. Total and unique network or system solution is required.

The telephone network can solve relay system failures by detour control. A local switching system, however, requires a unique solution because the system is connected directly to users.

To replace the entire telephone network with a general-purpose system, the OS must support measures against the above problems a) to c). It is not too far to say that an entire network can be established on general-purpose machines only if this kind of OS is developed.

5. CONCLUSION

To offer a network system suited to the new age, this paper proposed the construction of a communications system on general-purpose machines that could offer better and wider range of services. At present, UNIX-based fault tolerant computers (FTCs) are considered best for construction of a media conversion network. However, OSs for the network system will change over to Windows-based ones, due to increasing Windows-based terminals. Although some Windows-based FTCs have already been marketed, they are not as mature as the UNIX-based systems. Introduction of mature Windows-based FTCs with the discussed media conversion functions is eagerly waited, so that we could provide new network systems to cope with the new waves of communications.

REFERRENCES

[1] 1978 White Paper on Communications, Ministry of Posts and Telecommunications (1978)
[2] 1996 White Paper on Communications, Ministry of Posts and Telecommunications (1996)
[3] Koichiro Hayashi: Networking Economics, NTT Publishing (1989)
[4] Norio Shiratori: Communications Software Engineering, Baifukan (1995)
[5] Shimazaki, Endo, Yanagawa, et al.: Ultimate Communications Services - Possibility of Multimedia Communications, The 7th Symposium of Communications Services, Society of Electronic Information Communications (1993)
[6] Masahiko Shimazaki: Bird's-eye View of Electronic Information Networking Configuration and Subjects in the Multimedia Information Service Industry, Bulletin No. 5 by Development Engineering Department, Tokai University (1993)
[7] 1996 White Paper on Information Media, Dentsu Institute (1996)
[8] 1996 White Paper on Internet Business, Japan Applied Research Institute (1996)
[9] Liberalization of Communications, General Laboratory of Information Communications (1996)
[10] G. J. Myers: Composite/Structured Design, Litton Educational Publishing (1978)
[11] M. A. Jackson: System Development, Prentice/Hall International (1983)
[12] Hiroteru Yanagawa: Interworking between Multimedia Communications Network and Existing Network, The 5th Meeting of Communications Software Engineering, Society of Electronic Information Communications (1996)
[13] 1995 Civilian Power, Asahi Shimbun (1995)
[14] Information Communications Handbook '97, General Laboratory of Information Communications (1997)

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Solutions for Remote Multimedia Access using Network Managed VSAT's and the International ISDN Standard

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ABSTRACT

The majority of satellite based commumnications systems have been developed with telephony and low rate data in mind. Users are now demanding enhanced services not available in these systems. This paper will address a VSAT based ISDN system providing enhanced digital services via satellite.

Satellite based Telecommunications Networks have been slow to provide users with the enhanced services that are normally available in today's sophisticated terrestrial networks. VSAT systems have provided users with low-rate data and basic telephony services for many years with little, if any changes in the services offered. Flexibility is definitely not a description that could be applied to the majority of VSAT Networks that are in operation around the World today.

As users have become more sophisticated in their uses of telecommunications technology, Countries in areas such as Asia/Pacific have begun to demand Enhanced Telecommunications services. The question of how to provide these services via satellite in an environment that has been structured based on basic telephony and low-rate data is of interest to everyone.

A Universal standard exists which will allow high-speed connection to the Internet, LAN-to-LAN connections, Video Conferencing, Distance Learning and Standard Telephony. This standard is the ISDN standard. ISDN uses a Basic Rate Interface (BRI) that provides two (2) 64Kbps data pipes (B Channels). ISDN is extremely flexible in the possible ways that the system can be configured. It can be configured as simply as one (1) 'B' channel or even a combining two (2) 'B' Channels in one (1) direction to provide a 128Kbps pipe. The ISDN Standard allows "dial-up" connections to be established to provide all of the above services. An added advantage is the availability of "off-the-shelf" products (ISDN Modems) that will work with most standard PC's. Modem costs in the low $100's are now typical.

A Network Managed VSAT System based on the ISDN Standard that provides all of the Enhanced Services described above and at reasonable costs, is long overdue. The VSAT System must provide a standard ISDN interface as well as Software to deliver flexible Video Conferencing and other ISDN related services. The system must be simple to implement and at the lowest possible cost to the end user.

Satellite Bandwidth Managed ISDN Services are based on single or multiple BRI's. BRI interfaces are defined as a 4-wire point-to-point (T) or point-to-multipoint (S) circuit. This interface can be configured as a Network Terminator (NT) or Terminal Equipment (TE). An NT interface provides network functionality to an application. A TE is necessary to connect to an ISDN Network.

EFData's Bandwidth Managed ISDN Network extends terrestrial-based ISDN Networks over the satellite and allows interconnection between two subscribers on the satellite network. Figures 1 and 2 illustrate the differences in the possible configurations.

Reference: Figures 1 and 2.

Network Management

A Network Management System (NMS) is responsible for managing the Network and bandwidth allocated to the network. The NMS provides the operator interface for configuring and administering the Network. It maintains a log of all network events, including Call Detail Records (CDR), Alarms and other Node reported events.

FIGURES/DIAGRAMS REFERENCE

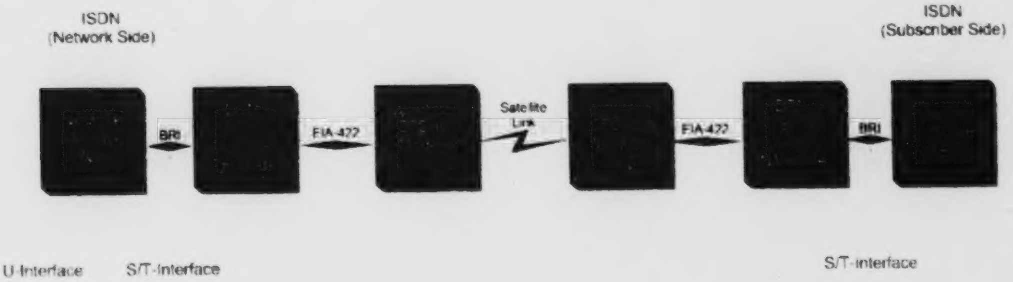
ISDN
(Network Side)
ISDN
(Subscriber Side)
BRI
EIA-422
Satellite
Link
EIA-422
BRI
U-Interface
S/T-Interface
S/T-interface

Figure 1. ISDN Subscriber to Network (Network Extension)

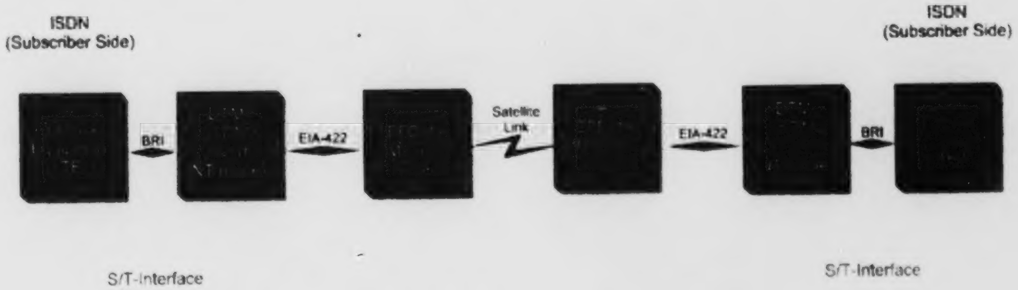
ISDN
(Subscriber Side)
ISDN
(Subscriber Side)
BRI
EIA-422
Satellite
Link
EIA-422
BRI
S/T-Interface
S/T-Interface

Figure 2. ISDN Subscriber to Subscriber (Private Network)

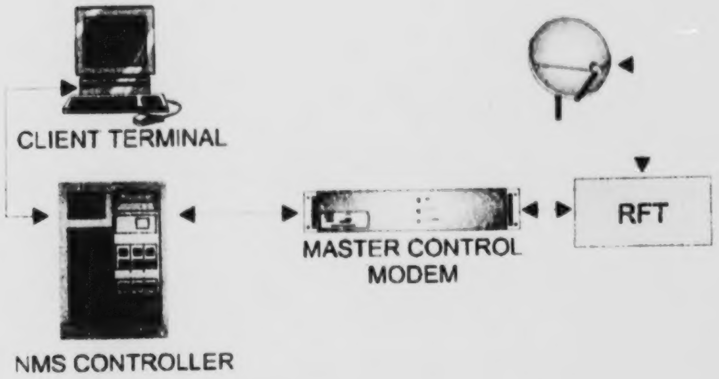
CLIENT TERMINAL
MASTER CONTROL
MODEM
RFT
NMS CONTROLLER

Figure 3. NMS Site

The operator can easily access these records to monitor and analyze network performance. The NMS can be configured a simply as required, or can integrated into an existing Hub. Figure 3 illustrates a simple Network Management System.

Reference: Figure 3.

Customer Site

A VSAT is installed at a customer site that requires ISDN. The equipment at the customer site consists of:

- Radio Frequency Transceiver (RFT) and Antenna
- Slave Control Modem
- Traffic Modem(s) (one per BRI)
- ISDN Converter(s)

Two types of ISDN converters are available. The D.I.C.A. 6400 supports single or multiple BRI's, while the D.I.C.A. 7300 supports a single BRI extension. The ISDN converter functions like an ISDN NT emulating a Central Office to the connected customer TE.

As a low-cost solution for single BRI circuit, a remote node can be set up with a single Control Modem providing both the Control Channel and Traffic Channel characteristics (*internal traffic mode* in EFData terminology). A D.I.C.A. 7300 is used as the IDSN converter. Figure 4 illustrates and example of a low-cost single channel (BRI) subscriber earth station.

Reference: Figure 4.

ISDN Hub

An ISDN node installed as an ISDN Hub provides an interface between the Bandwidth Managed Satellite Network and the Public Switched ISDN Network or a Private Terrestrial Network. The equipment used in this instance consists of:

- RF Equipment and Antenna
- Slave Control Modem
- Traffic Modem(s) (one per BRI)
- ISDN Converter(s)

The ISDN Converter presents itself as the TE to the Central Office NT. Figure 5., illustrates a site setup to act as an ISDN Hub providing two (2) BRI connections to a terrestrial network.

In this example, the Slave control Modem can manage multiple Traffic Modems.

Reference: Figure 5.

Call Procedures

The ISDN Converter emulates the basic functions of the ISDN Network when subscriber equipment is connected and "on hook". When the remote equipment attempts to establish a call, the ISDN Converter receives the signaling messages (D Channel) and provides the proper network response. The ISDN Converter sends the dialed ISDN number to the Slave Control Modem. The Slave Control Modem then passes a request (via satellite link) to the NMS to assign bandwidth for a BRI connection to the destination specified by the ISDN number. The NMS allocates the required bandwidth and informs the Slave Control Modems at both ends of the link of the allocated Traffic frequencies to be used by the Traffic Modems. The Traffic Modems are tuned to the assigned frequencies and an ISDN circuit is established.

During the connection process, the originating ISDN Converter generates the proper messages to the subscriber equipment to maintain the link in an "idle" condition. When the connection is made to the Converter on the terminating end, the 'B' and 'D' Channels are cut through so that information can be sent transparently.

Upon call termination by either end, the ISDN Converter informs the local Slave Control Modem, which in turn informs the NMS (via satellite). The NMS terminates the satellite circuit, releasing the bandwidth to the network.

Subscriber to Subscriber (Private Network)

The Bandwidth Management System (BMS) supports full ISDN connections between ISDN subscribers (TE) on the network. The ISDN Converters generate all network clocking and signaling functions required for the TE-to-TE connection. In this mode, the Phoenix Network provides the physical, data link, and network layers for the 'D' Channel.

The BMS supports full ISDN functionality without any connection to a terrestrial network. This feature is particularly useful for Corporate Video Conferencing, Data Sharing or Intranets where no terrestrial based service is available.

FIGURES/DIAGRAMS REFERENCE

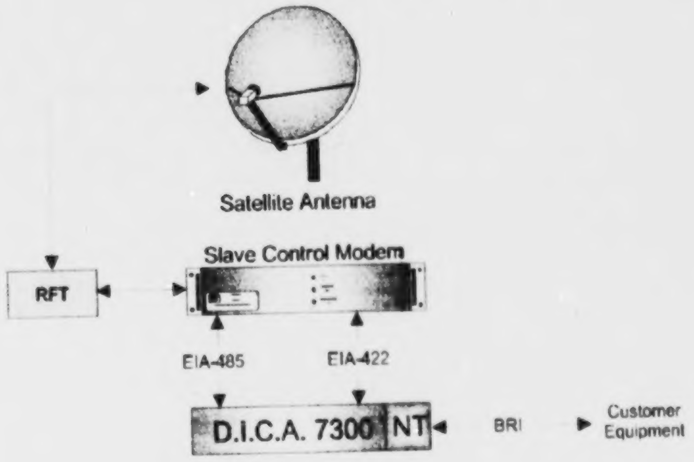
Satellite Antenna
Slave Control Modem
RFT
EIA-485
EIA-422
D.I.C.A. 7300
NT
BRI
Customer Equipment

Figure 4. Subscriber (TE) Site

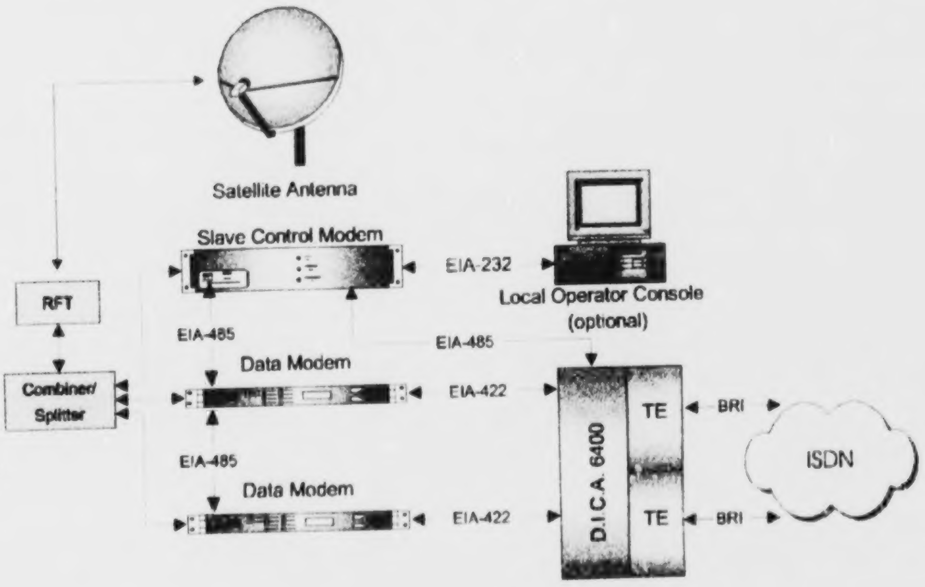
Satellite Antenna
Slave Control Modem
EIA-232
Local Operator Console (optional)
RFT
EIA-485
EIA-485
Data Modem
Combiner/ Splitter
EIA-422
EIA-485
Data Modem
EIA-422
D.I.C.A. 6400
TE
TE
BRI
BRI
ISDN

Figure 5. ISDN Hub Site,

BEST COPY AVAILABLE

Subscriber to Network Access (Network Extension)

The BMS also supports TE-to-NT connections from a subscriber to an ISDN Hub with a Terrestrial ISDN Network access. This mode is commonly used for Internet access, Remote LAN connections and Telecommuting. In this case, the network provides the clocking, protocol translation, and other related functions provided by the network and higher Open Systems Interconnection (OSI) layers. The BMS provides the physical and data link layers for the 'D' Channel. The connection to a Public Network can be used to dial any location Worldwide, even where non-ISDN subscribers are located.

Call Control Protocols

There are different standards for ISDN D-Channel call control protocols in different regions of the World. The ISDN Converter supports the two (2) most common protocols: National ISDN 1 (NI-1) and the Euro-ISDN (DSS-1). NI-1 is commonly used in North America. The DSS-1 standard is commonly used throughout most of Europe, Asia, South America and Africa.

In addition, an ISDN switch at one site in a link can be used to perform the conversion from one protocol to another. This allows satellite-based networks in which each side runs a different protocol. The switch can support Gateway functions to other ISDN standards such as AT&T 5ESS, Nortel DMS-100, German 1 TR6, French VN4, Japanese NTT, Hong Kong CR22, Singapore FETEX, Australian TS-013, or others.

Single BRI Access Modes and Data Rates

The BMS provides several methods of accessing ISDN Bandwidth across the satellite. The usual data rate of an ISDN BRI interface of 192Kbps has been reduced to:

- 1 B + D, no X.25/X.31
  80Kbps
  One B Channel operates at 64Kbps and the D Channel supports the signaling traffic.

- 1 B + D, X.25/X.31
  96Kbps
  One B Channel operates at 64Kbps and the D Channel supports the signaling traffic and additional X.25/X.31 data traffic with a data rate of up to 9.6Kbps.

- 2 B + D, X.25/X.31
  160Kbps
  The two B Channels operate at 64Kbps each and the D Channel supports the signaling traffic and additional X.25/X.31 data traffic with a data rate of up to 9.6Kbps.

Multiple BRI Access Modes and Data Rates

Higher data rates than provided by a single BRI are commonly used for High Quality Video Conferencing, Compressed Video and similar applications. The BMS has the capability to multiplex up to four (4) BRI's over a single satellite circuit. The following data rates are supported:

- 4 B + 2D, X.25/X.31
  312Kbps

- 6 B + 3D, X.25/X.31
  464Kbps

- 8 B + 4D, X.25/X.31
  616Kbps

Multiple Destinations

The ISDN standard supports multiple destinations by establishing each B Channel call as a separate event. The BMS operates using SCPC Traffic Circuits that are fully allocated and established when the subscriber's ISDN device goes "off hook" and dials a number. This means that a 2 B + D call from a given BRI device can go to one physical destination at a time. Two separate B Channel destinations can be handled if the call is passed through a Terrestrial Hub connected to an ISDN Switch, since the Switch can provide routing for the B Channels as required.

Network Topology

The ISDN Network has a full MESH topology with links supported for subscriber-to-subscriber and subscriber-to-ISDN Network traffic. An ISDN Gateway site will frequently contain a Switch or PBX for local management of B Channel routing.

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A sample Network with two (2) BRI's at one customer site and one (1) BRI at another customer site is illustrated in figure 6.

Reference: Figure 6.

This network supports mixed application-to-application and application-to-network connections. The call connection protocol conveys the information to define the required network functionality. If a call is made between ISDN application sites, the ISDN Converter acts as the network surrogate. If a call is made between an application (TE side) and a site that has a link to a Terrestrial Network (NT side), the ISDN Converter transparently passes the network functionality from the network.

Conclusion

ISDN offers users a variety of applications within the one standard. Users can utilize all the benefits of a standard telephone network and at the same time have complete "dial up" access to a wide variety of data based services. The cost of implementing a satellite based ISDN Network is now competitive with standard telephony offerings, with the exception of the bandwidth used per call. As users demand Enhanced Service offerings such as High-Speed Internet connection, Video Conferencing and Remote LAN connections. ISDN is able to deliver all of these demands today and at a reasonable cost for the service.

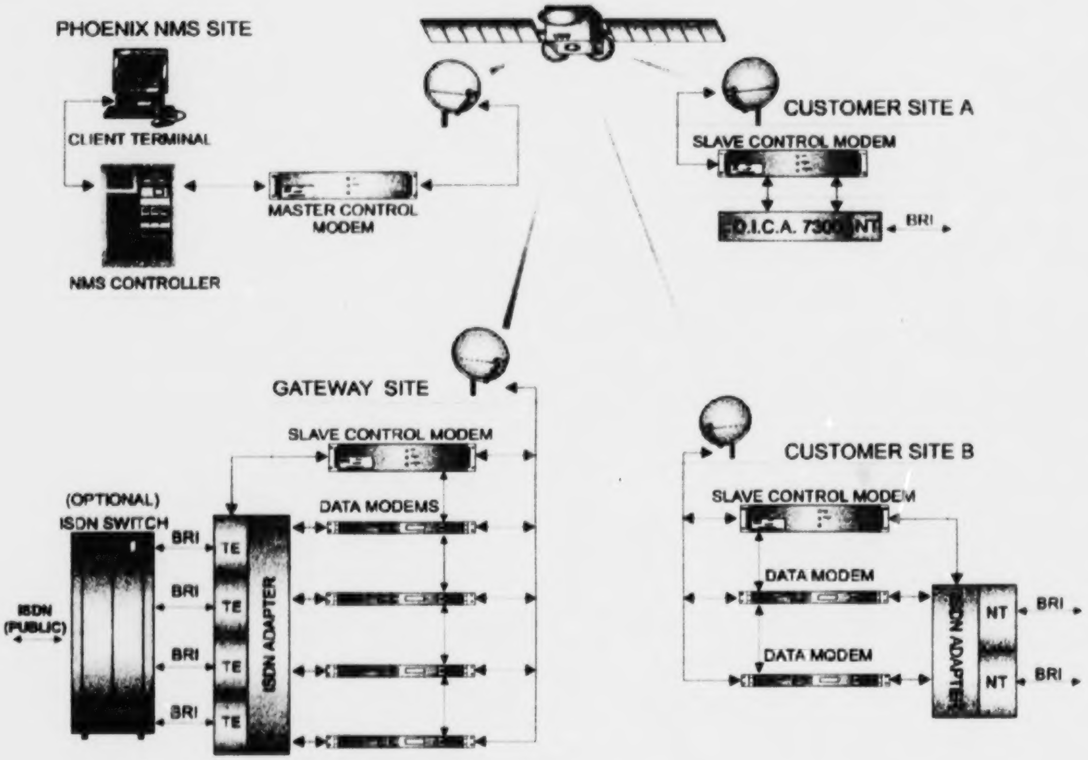
PHOENIX NMS SITE
CLIENT TERMINAL
NMS CONTROLLER
MASTER CONTROL MODEM
CUSTOMER SITE A
SLAVE CONTROL MODEM
D.I.C.A. 7300
NT
BRI
GATEWAY SITE
SLAVE CONTROL MODEM
DATA MODEMS
(OPTIONAL) ISDN SWITCH
ISDN (PUBLIC)
BRI
BRI
BRI
BRI
TE
TE
TE
TE
ISDN ADAPTER
CUSTOMER SITE B
SLAVE CONTROL MODEM
DATA MODEM
DATA MODEM
ISDN ADAPTER
NT
NT
BRI
BRI

Figure 6. ISDN Network

Multimedia network architecture for supporting the lifestyle in the twenty-first century

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*2 Nippon University, Japan

1. Abstract

In this paper, we predict future work styles by modeling current enterprise organizations and determine the architecture that will be needed for smooth communications Specifically, we propose a two-layered multimedia network architecture consisting of information and communication layers The information layer uses decision-making agents, whereas the communication layer uses a communication agent The decision-making agents support decision making that requires advanced types of communication, such as negotiation and persuasion, in a distributed-office environment The communication agent supports bi-directional communication by managing positional information about communicating entities and selecting the optimum paths and media for communication

2. Introduction

The twenty-first century will see demands for distributed office systems that are free of time and spatial restrictions, such as small and home offices (SOHOs) This demand will result from the possibility these systems offer in solving urban problems (such as highly concentrated populations and air pollution), in coping with demands for changes in the lifestyle of office workers, and in enabling higher work efficiency Use of the Internet and intranets is being promoted to establish information/communication infrastructures in distributed-office systems It is becoming technically possible for an office worker to do the same work at any location To realize a comfortable lifestyle, however, it is necessary to produce an innovative information/communication system that can smooth communications among people In this paper, we forecast the work style of the twenty-first century using enterprise organization models We also examine multimedia network architectures that can provide a more comfortable lifestyle by analyzing the necessities for smooth communication

3. New Work Style for Creating a More Comfortable Life Style

A new work style stressing human considerations is essential for creating a more comfortable life style We have examined the features necessary for the new work style, listing them below

(1) Individuals are the key to the efficient working of an organization (Figure 3 1)

The traditional work style consists of two extremes At one extreme, individuals must subordinate themselves to the organization At the other extreme, individuals are supreme, and the organization lacks cohesion In the future, the organization must still function efficiently, but at the same time ensure that individuals fully develop their capabilities

(2) Automating non-routine work (Figure 3 2)

Non-routine work will increase in the future Whereas routine work is easily automated because each problem has a single solution, non-routine work is difficult to automate because a problem has more than one solution In the future, it will be important for us to determine automatically the optimum solution from more than one solution

(3) Automatic acquisition of needed information (Figure 3 3)

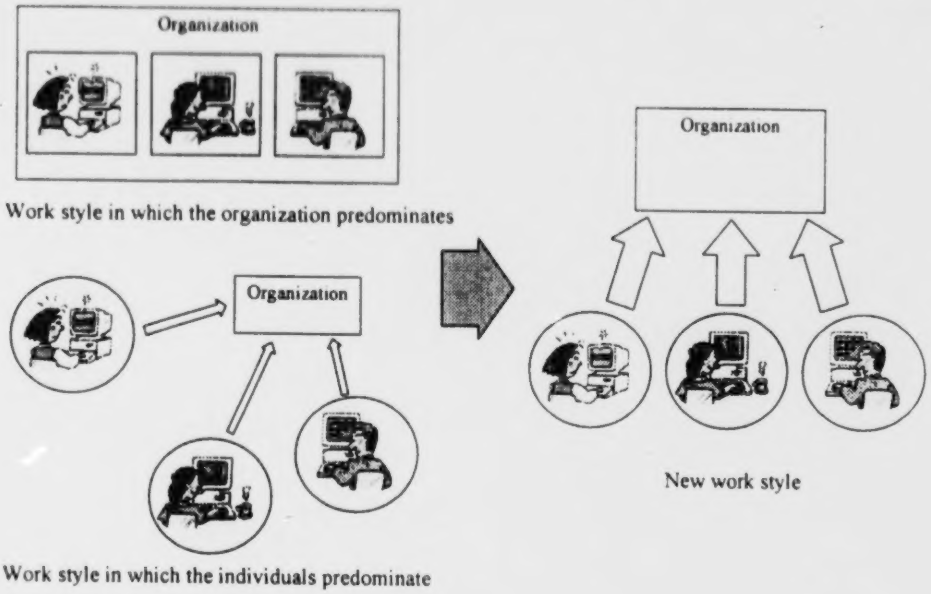

Organization
Work style in which the organization predominates
Organization
Work style in which the individuals predominate
Organization
New work style

Figure 3. 1 WORK STYLE THAT ALLOWS INDIVIDUALS TO DEVELOP THEIR CAPABILITIES.

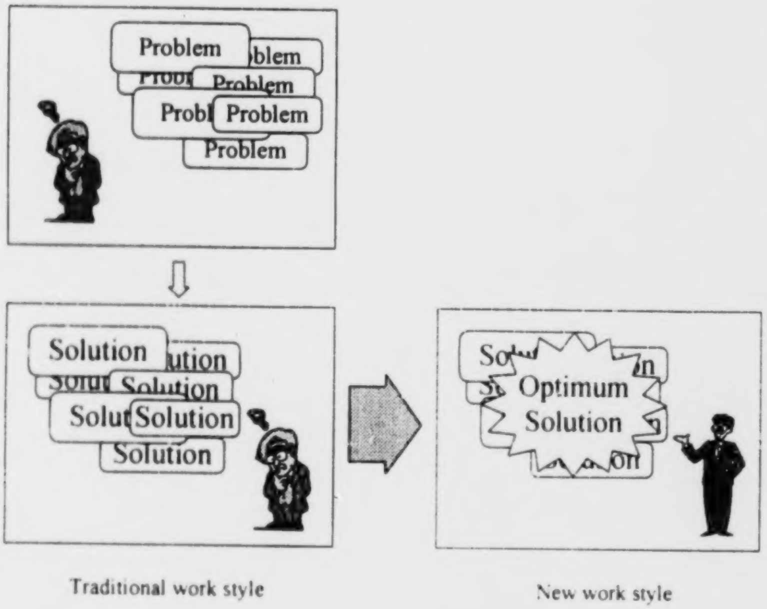
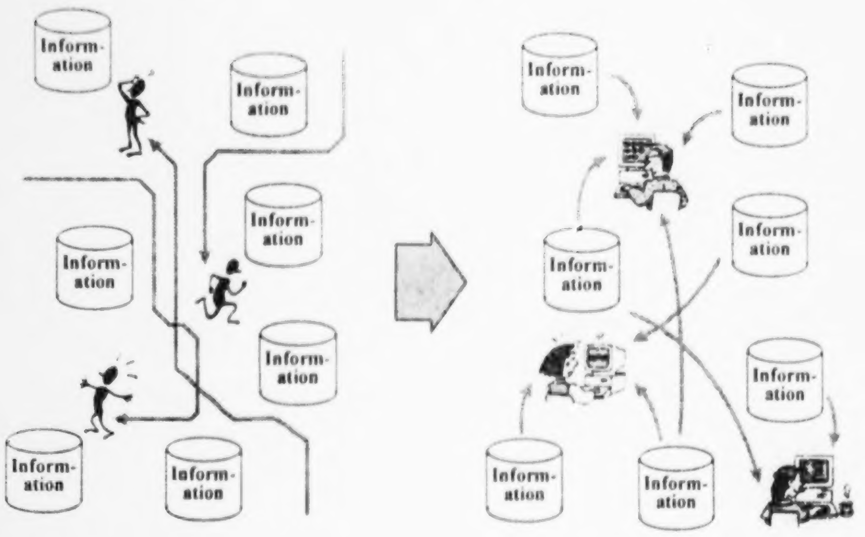

Problem
Problem
Problem
Problem
Problem
Problem
Problem
Solution
Solution
Solution
Solution
Solution
Solution
Solution
Optimum Solution
Traditional work style
New work style

Figure 3. 2 WORK STYLE THAT EFFICIENTLY SOLVES PROBLEMS IN NON-ROUTINE WORK


Inform-
ation

Traditional work style

New work style

Figure 3. 3 WORK STYLE IN WHICH REQUIRED INFORMATION IS EASILY ACQUIRED

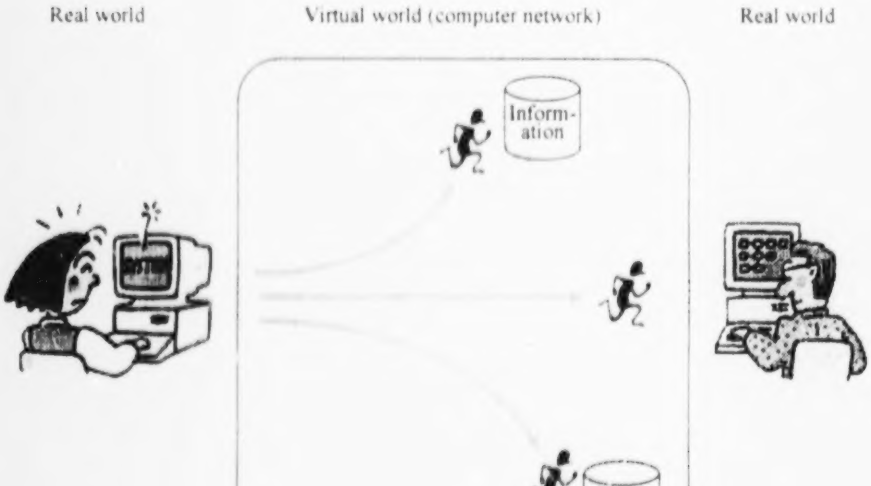

Real world
Virtual world (computer network)
Real world
Inform-
ation
Inform-
ation

Figure 3. 4 WORK STYLE LINKING THE REAL WORLD WITH A VIRTUAL WORLD

An enormous amount of time is usually spent finding and selecting needed information. We need to switch to a push-type technology for information contents, which will allow needed information to be delivered automatically.

(4) Linkage with a virtual world (Figure 3.4)
The real world, which we inhabit with other human beings, will need to be linked seamlessly to a virtual world on a computer network, where we will interact with network resources as if they were living entities. For this interaction to be effective, the virtual world must be provided with mechanisms, or agents, that take into account our personalities as users as they work on our behalf.

This paper focuses on the characteristics of (1) above. Figure 3.5 locates the new work style graphically in the quadrant defined by increased workshop distribution (right on the horizontal axis) and increased importance of the individual (up on the vertical axis). Traditional office systems, on the other hand, have supported the work style defined by the lower-left quadrant. The progress of communication technologies such as the Internet and CTI have enabled today's office systems to support the work style defined by the lower-right quadrant. The following chapters discuss the environment required to support the next-generation work style defined by the first quadrant. This new work style will merge communication and decision-making technologies to focus on the individual without also losing sight of organizational efficiency.

4. Enterprise Model and Functions Required for New Work Style

4.1 Enterprise models

To determine a multimedia network architecture that supports a new life style, it is first necessary to model an enterprise in order to understand the organization and activities of general enterprises. Generally, the organizational structure of an enterprise is hierarchical, for example, department -> section -> project. Enterprise resources, such as funds, facilities, and information, are assigned according to the hierarchical structure of the enterprise. The chain-of-command and decision-making systems of the enterprise also function according to a hierarchical structure. Generally, each role in specialized office work has a higher degree of freedom and independence compared with routine work. Meanwhile, hierarchical structures can be reconfigured to optimize them according to the goals of the enterprise.

To represent an organizational structure while keeping each role in the office independent from one another, we paid attention to the configuration units of organizational functions and the links between them. We defined the configuration units of organizational functions by dividing them into smaller functions, like department -> section -> project -> group, as role spaces. Figure 4.1 shows the configuration of role spaces. A role space is a virtual object that realizes unit functions by dividing an enterprise organization and defining the unit functions in detail. Each virtual object consists of elements such as a purpose, enterprise resources, and processes. In other words, a virtual object is a field where a given mission or duty is carried out in order to achieve the goals of the entire organization. A role space generates lower-order role spaces when it divides its functions into smaller functions and defines them in detail in order to achieve goals. In a hierarchical structure, a role space (such as a department or section) has the authority to manage the purpose, enterprise resources, and processes of a role space (such as section or project) under it. At the same time, a role space inherits the purpose, enterprise resources, and processes of the role space above it.

Meanwhile, in an actual enterprise organization, a worker in a role space carries out the mission of the role space according to the processes and schedule defined by utilizing the enterprise resources in the role space.

4.2 New work style model

Distributed offices are being used to solve urban problems such as overcrowding, long commutes, and air pollution. In a distributed-office environment, remote workers can work together without gathering in one place. An example of this might include a satellite office, a local office, a resort office, a small office, and a home office.

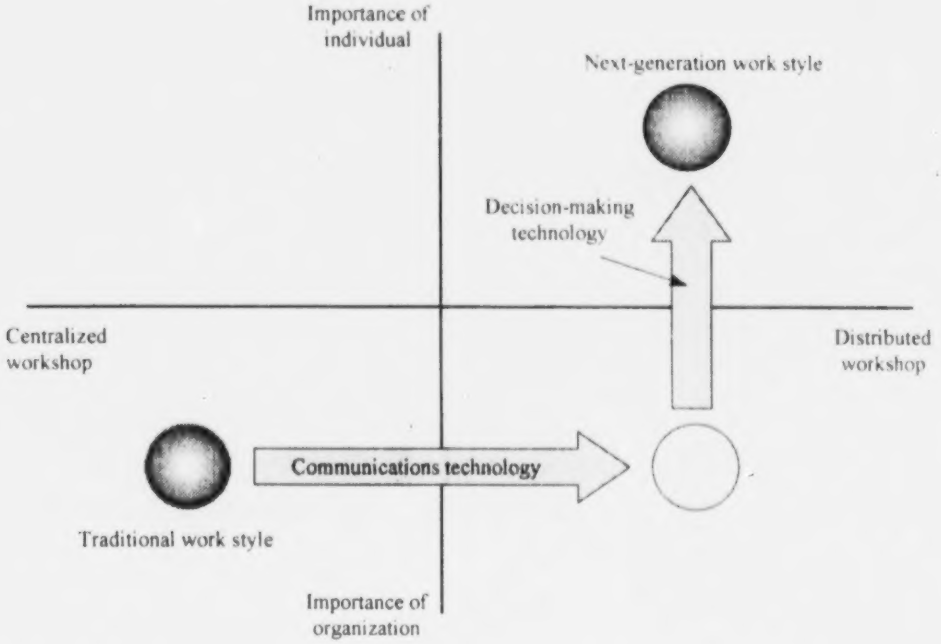

Importance of individual
Next-generation work style
Decision-making technology
Centralized workshop
Distributed workshop
Communications technology
Traditional work style
Importance of organization

Figure 3. 5 RELATIONSHIP OF WORK STYLES

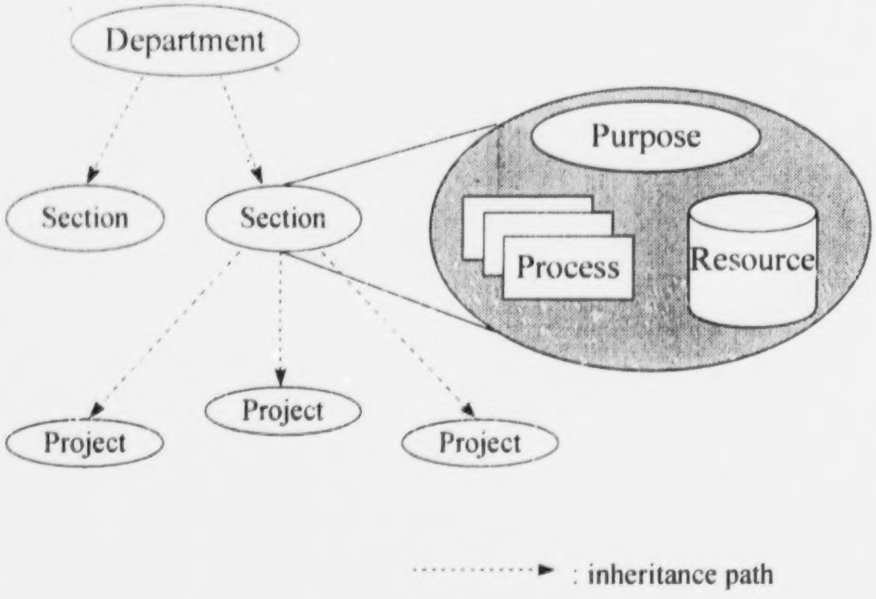

Department
Section
Section
Purpose
Process
Resource
Project
Project
Project
: inheritance path

Figure 4. 1 ROLE SPACE CONFIGURATION

We anticipate that in the future, individuals' sense of value and their view of work will diversify. This will lead to demands for work to adapt to suit their lifestyles. In this new work style in which people are the central concern, work hours will vary between workers. To put it in another way, the major work style trend in the future will be that offices are distributed not only geographically but also temporally.

From the viewpoint of enterprise organizations, flexible, small-scale organizations rather than conventional large-scale vertical divisions will be needed to efficiency cope with an increase of jobs that require a high level of intelligence. Sharing information equally among small organizations could make it possible to solve problems quickly and meet demands flexibly by adapting the configuration of the organization to its environment. From the viewpoint of individual workers, this means taking responsibility for a number of subdivided functions.

Figure 4.2 shows an enterprise model that suits the new work style explained above. In this model, role spaces are subdivided at a level of individual workers. The smallest unit of an organization is a worker. Individual workers have different goals and resources to execute processes to achieve their goals.

(1) Role spaces are distributed both geographically and temporally

The work places of individuals are distributed geographically. In addition, they have different work hours. Furthermore, the resources available to an individual worker are not necessarily in the same place, hence the need for role space distribution.

(2) Workers belong to more than one role space

Each worker has more than one role in an enterprise organization. The worker carries out his or her jobs simultaneously, hence role space multiplexing.

4.3 Functions required for new work style

The process of a role space is that executed to achieve the goals of the role space. Generally, office work in an enterprise could consist of two phases: decision making and work execution. The term "decision making" means selecting the best choice from those available to solve potential problems in the course of achieving goals. The term "work execution" means to produce work output by utilizing the allotted enterprise resources.

The work execution phase consists largely of routine work, while the decision-making phase is mainly non-routine intellectual work, which will increase in the future. Collecting the information needed to make the best choice is fundamental to decision making. Group decision making will require discussions, negotiations, and persuasion among the members or subgroups of the group.

In the prior section, we considered the distribution and multiplexing of role spaces as features of an enterprise model reflecting the new work style. Any decision making related to these features requires the following functions (Figure 4.3).

(1) Role space distribution

Smooth communications between role spaces. This function enables smooth communications between persons who are separated geographically and/or temporally. It also enables the collecting of information from geographically remote places.

(2) Role space multiplexing

Extraction of information necessary in a role space. This function enables the exact information necessary to be extracted for carrying out duties in a role space.

5. Multimedia Network Architecture for Supporting New Work Style

5.1 Architecture for supporting new work style

In the previous chapter, we clarified the functions necessary for the new work style. In this chapter, we propose a multimedia network architecture (Figure 5.1) to implement these functions. This multimedia network architecture consists of communication and information layers, which are established above the physical layer of networks, media, and data. The information layer offers the two functions (communication between role spaces and the extraction of necessary information in individual role spaces) explained in the previous chapter to solve problems posed by users. These functions are implemented with decision-making agents. The communication layer is required to conceal locations,

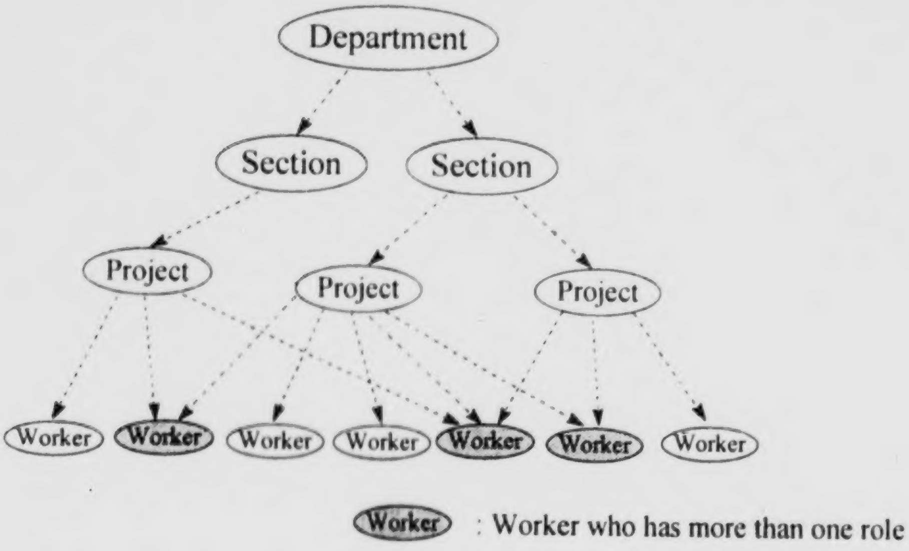

Department
Section
Section
Project
Project
Project
Worker
Worker
Worker
Worker
Worker
Worker
Worker
Worker : Worker who has more than one role

Figure 4. 2 ROLE SPACES IN NEW WORK STYLE

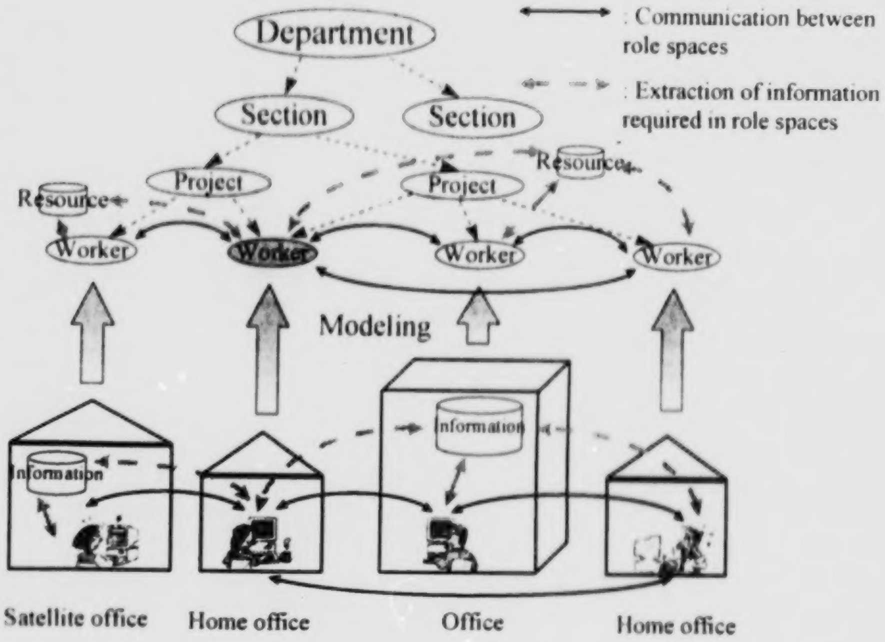

: Communication between role spaces
: Extraction of information required in role spaces
Department
Section
Section
Project
Project
Resource
Resource
Worker
Worker
Worker
Worker
Modeling
Information
Information
Satellite office
Home office
Office
Home office

Figure 4. 3 FUNCTIONS REQUIRED IN NEW WORK STYLE

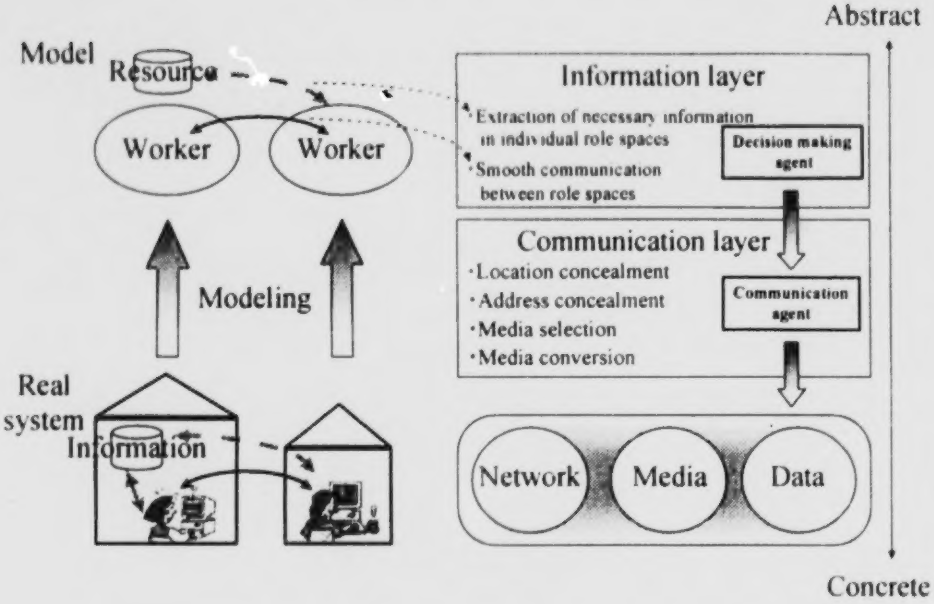

Abstract
Model
Resource
Worker
Worker
Information layer
·Extraction of necessary information in individual role spaces
·Smooth communication between role spaces
Decision making agent
Communication layer
·Location concealment
·Address concealment
·Media selection
·Media conversion
Communication agent
Modeling
Real system
Information
Network
Media
Data
Concrete

Figure 5. 1 TWO-LAYERED ARCHITECTURE

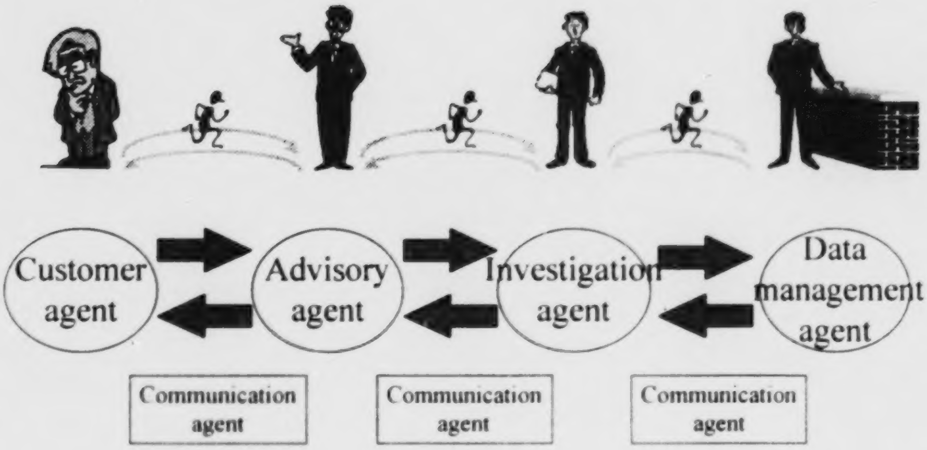

Customer agent
Advisory agent
Investigation agent
Data management agent
Communication agent
Communication agent
Communication agent

Figure 5. 2 DECISION-MAKING AGENTS

manage addresses, and to select and convert media These functions are implemented with a communication agent

5.2 Information layer and decision-making agents

There are four decision-making agents in the information layer, as shown in Figure 5 2 These four are defined as follows

- Customer agent Manages requests (or problems) from users
- Advisory agent Decides on actions necessary to solve problems
- Investigation agent, Collects information
- Data management agent Manages information and provides it to the investigation agent

Let's suppose that a user has to determine the price of a product If the user assigns this problem to the customer agent, the agent compares the problem with problems the user has previously assigned and identifies the user role and the target area to which the problem belongs Having identified the target area, the agent requests the advisory agent that covers that target area to solve the problem

When assigned this problem, the advisory agent determines the actions needed to solve the problem Information such as the development and production costs of the product and the market price of similar products would be necessary to determine the price of the product Information such as sales and profit forecasts for specific prices might also be necessary In addition to this numerical information, the experience and intuition of salespersons that have long been engaged in the marketing of similar products may be important in determining the price of the product Consequently, the advisory agent asks the investigation agent to collect whatever pertinent information is available in the system

The investigation agent accesses and collects the desired information The data management agent, responsible for information management, presents the information requested by the investigation agent Depending on its type, information required from storage may have to undergo retrieval, analysis, and computation before being presented to the investigation agent

The advisory agent organizes the information collected by the investigation agent and presents it to the user It also opens a path for mutual communications so that the user and an experienced salesperson can exchange ideas smoothly

In this way, the new architecture can collect the information necessary to solve problems and enable smooth communications among people, thereby firmly supporting decision making in the new work style The communication agent in the communication layer is responsible for mediating communications and information transfers between other agents and communications between users and salespersons

5.3 Communication layer and communication agent

The communication agent is located in a higher section of the communication layer, which supports the information layer This agent facilitates communications among the four agents as requested by them for the decision-making process Figure 5 3 shows the functions of the communication agent

- Location concealment The locations of people and information are managed in such a way that the information layer need not be aware of the locations of communicating entities
- Address concealment The addresses of people and information are managed in such a way that the information layer need not be aware of the addresses of communicating entities
- Media selection Media owned by communicating entities are managed in such a way that the media best suited for a specific request from the information layer is selected
- Media conversion If a communicating entity does not have the optimum media for a request from the information layer, media conversion is performed so that the information layer need not be aware of the media type of the communicating entity

Figure 5 4 shows a communication layer model The communication agent is in the upper section of the communication layer, while the following control functions are in the lower section

- Network management Manages network switching

and routing.
- Media management: Stores and reproduces sound, still pictures, moving pictures, and text data, and converts them from one form to another.
- Database management: Reads, writes, and searches for common data.

The communication agent implements the communication agent functions shown in Figure 5.3 by fully utilizing network management, media management, and database management.

6. Applying Agent Functions to Computer Telephony Integration

To verify the validity of the architecture described so far, we applied the agent functions to developing systems based on computer telephony integration (CTI) technology. Given below are examples of applying the communication agent. The first example is a telecommuting system. The other is an Internet telephony gateway system in which map information is used.

6.1 Telecommuting system

6.1.1 System overview

The telecommuting system offers the same environment for a remote office as for the main office. When an office worker is in a remote office, the PBX and CTI servers working in cooperation automatically forward the calls received at the main office for that person to the remote office. The CTI server provides workers at remote offices with information on the calling party over the Internet. Figure 6.1 outlines the telecommuting system.

6.1.2 System configuration

Figure 6.2 shows the configuration of the telecommuting system. In this system, a CTI server having switching functions is connected to a PBX, which retains public telephone network lines and extension lines, via voice lines and a CTI link. The CTI link is used to transmit application programming interface (API) information to control or monitor the calls of PBX. The PC at the telecommuter is connected to the CTI server over the Internet.

6.1.3 Roles of the CTI server

The CTI server has the following roles.

- Telecommuter location concealment: Prevents the calling party from noticing that the called office worker is telecommuting. (Communication agent function)
- Switching control: Automatically forwards calls to the telecommuter.
- Obtaining the status of calls on extension lines retained in the PBX: Receives information on the calling party (such as the calling party number) and the status of a PBX extension line via the CTI link, and sends them to the PC at the telecommuter.
- Session control: Controls sessions to synchronize switching control and LAN control as directed from the PC at the telecommuter to control the various services provided by the PBX.

6.2 Internet telephony gateway system utilizing map information

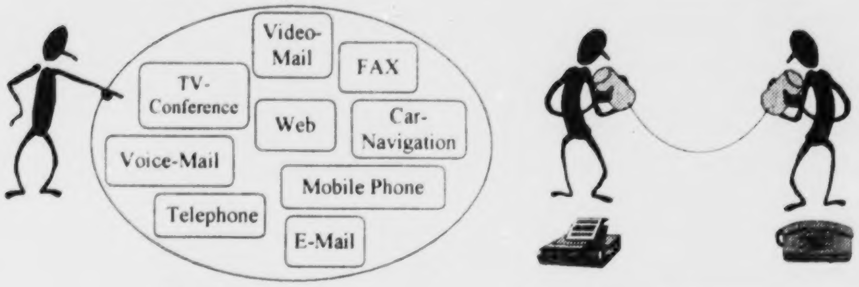
6.2.1 System overview

The map information-based Internet telephony gateway system enables a user to initiate a call over the Internet telephone by clicking on a building or person rendered on a map displayed by a web browser instead of dialing the telephone number of the remote party. Using the Internet telephony gateway function in the CTI server, the calling party can talk with the shop or person on an ordinary telephone without disconnecting from the Internet. Figure 6.3 outlines the Internet telephony gateway based on map information.

6.2.2 System configuration

Figure 6.4 shows the configuration of the telephony gateway system. In this system, the map information server sends map information to the web server over the Internet. The web server adds personal information to the received map information on a home page and sends it over the Internet. The calling party's PC has a web browser and an Internet telephone application and is connected to the web server and CTI server over the Internet. The CTI server is connected to both the Internet and the public telephone network, thus enabling communications

Location concealment   Address concealment


Video-Mail
FAX
TV-Conference
Web
Car-Navigation
Voice-Mail
Mobile Phone
Telephone
E-Mail

Media selection   Media conversion

Figure 5. 3 COMMUNICATION AGENT FUNCTIONS

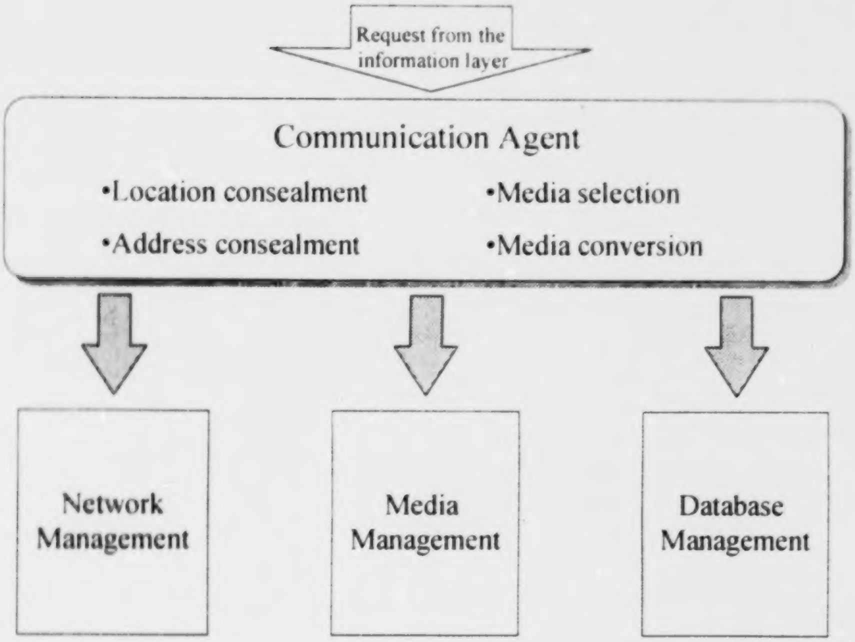

Request from the information layer
Communication Agent
•Location consealment
•Media selection
•Address consealment
•Media conversion
Network Management
Media Management
Database Management

Figure 5. 4 COMMUNICATION LAYER MODEL

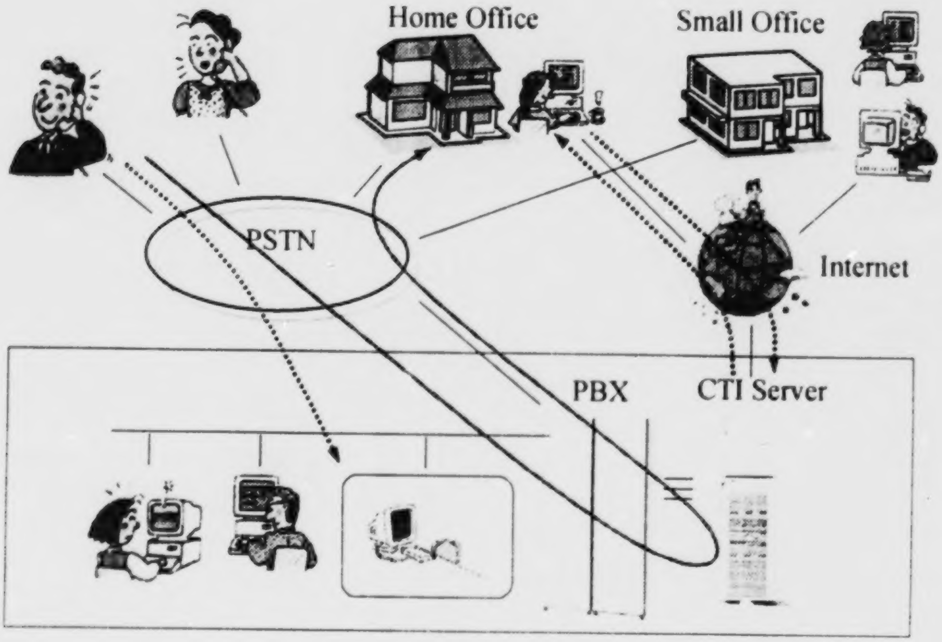

Home Office
Small Office
PSTN
Internet
PBX
CTI Server

Figure 6. 1　TELECOMMUTING SYSTEM OVERVIEW

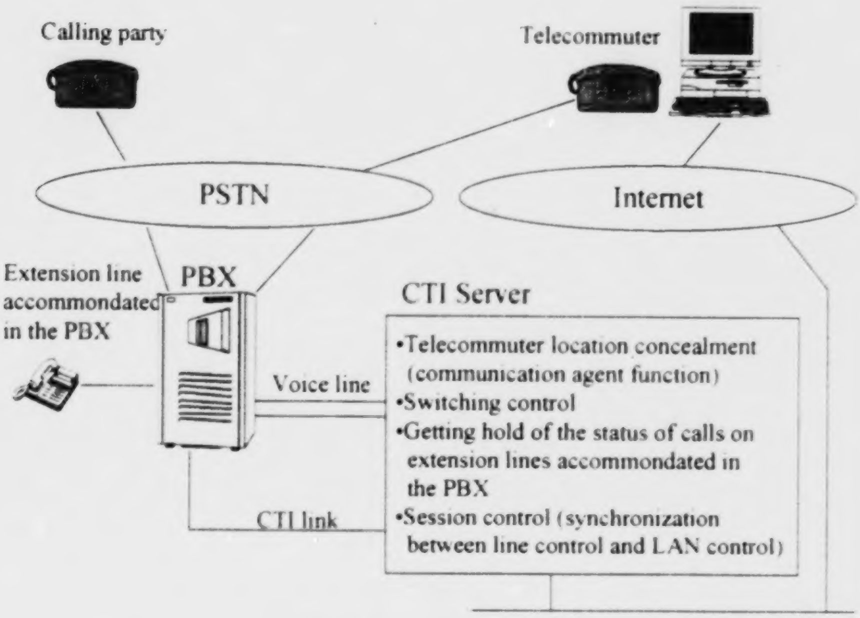

Calling party
Telecommuter
PSTN
Internet
Extension line accommondated in the PBX
PBX
CTI Server
•Telecommuter location concealment (communication agent function)
•Switching control
•Getting hold of the status of calls on extension lines accommondated in the PBX
•Session control (synchronization between line control and LAN control)
Voice line
CTI link

Figure 6. 2　TELECOMMUTING SYSTEM CONFIGURATION

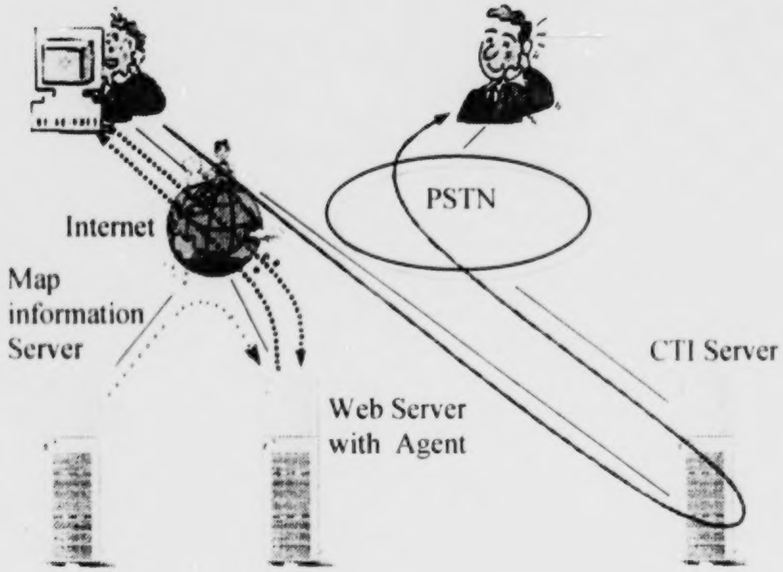

Internet
Map
information
Server
PSTN
CTI Server
Web Server
with Agent

Figure 6. 3 MAP INFORMATION-BASED INTERNET TELEPHONY GATEWAY SYSTEM OVERVIEW

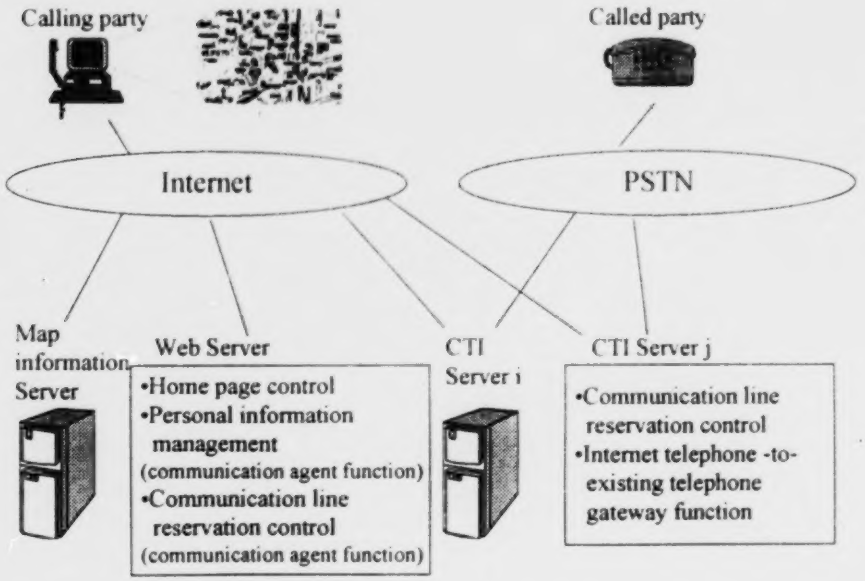

Calling party
Called party
Internet
PSTN
Map
information
Server
Web Server
•Home page control
•Personal information
management
(communication agent function)
•Communication line
reservation control
(communication agent function)
CTI
Server i
CTI Server j
•Communication line
reservation control
•Internet telephone -to-
existing telephone
gateway function

Figure 6. 4 MAP INFORMATION-BASED INTERNET TELEPHONY GATEWAY SYSTEM CONFIGURATION between the Internet telephone and the existing telephone

6.2.3 Roles of the web server

The web server has the following roles

- Home page control Presents a home page on which personal information is added to the map information received from the map information server
- Personal information management Displays detailed information and presents information for Internet telephone connections according to the personal information on the home page (Communication agent function)
- Communication line reservation control When an Internet telephone connection is requested, this searches for a CTI server that can be used to communication with the called party It then sends the telephone number of the called party and a request for line reservation to the CTI server and then sends the IP address of the CTI server to the calling party (Communication agent function)

6.2.4 Roles of the CTI server

The CTI server has the following roles

- Communication line reservation This reserves all resources necessary to enable communications after receiving a line reservation request from the web server
- Internet telephone-to-existing telephone gateway function Converts voice packets over a LAN to conventional voice signals and vice versa to enable communications

6.4 Evaluation

The telecommuting system links a PBX with CTI servers It implements location concealment, which is one of the communication agent functions, by using existing PBX services and having CTI servers control the synchronization between a communication line and the LAN The map information-based Internet telephony gateway system implements communication agent functions such as address concealment and media conversion in part by providing web servers with a personal information management function and a CTI server link function and CTI servers with a gateway function We have confirmed that both systems have a sufficient communication system-grade performance compared with existing communication systems

7. Conclusion

Our network architecture aims to promote a comfortable lifestyle in which people can work while having optimum communications in any place at any time We think the systems introduced for evaluation in this paper are the first step toward such a lifestyle, though they lack many of the communication agent functions required in a communication layer We are planning to enhance the communication agent functions and install decision-making agents in the information layer These systems will eliminate the problem of commuting for disabled people and obstacles that face aged people in usual working conditions We will be satisfied if this paper is helpful to those who share the goal of realizing a comfortable lifestyle

8. References

(1) Nakamura, Takagi, and Kiyokane, "Practice and Application of Teleworking--in Quest for New Work Style--," Fujitsu in-house paper, (1995)

(2) Etani, Kannda, Nakamura, Shitaji, Kitamura, Fujii, and Fujimoto, "Proposal of Enterprise Information/ Communication System Based on Office Work," Institute of Electronic Information/Communication Engineers, (1995)

(3) Takeuchi, Ohashi, Sato, Kono, and Fujimoto, "Method for Constructing Agent-Based Decision-Making System," Institute of Electronic Information/Communication Engineers, (1997)

(4) Nakamura, Masuda, Araki, Furukawa, and Kiyokane, "Role of Multimedia Communication in the Teleworking and Telelearning Field," PTC '94

Asian telecom deregulation over the next five years; looking to the past to see the future.

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ABSTRACT

What directions can be expected from Asian telecom sectors over the next five years? Will telecom de-monopolisation, deregulation and liberalisation be encouraged through user demand, reluctantly agreed to by governments because of international trade threats, or accepted as a the only means for national development?

These are broad questions and an informed opinion can be arrived at by looking at the history of deregulation and de-monopolisation in different markets and assessing why and how the process of liberalisation began.

Contrasts in Asian markets

Through an understanding of the history of deregulation in three markets: India, China and Malaysia, an understanding can be developed that while the international pressures behind the opening of telecom sectors has been similar, the driving forces behind that liberalisation has been fundamentally different in each country. A simple point, but one that is all too often ignored by western-based telecommunications companies looking for business in Asia.

India and China have been chosen because they are the largest markets in Asia and because they provide the broadest possible political and social contrasts.

In India, the world's largest democracy, the principle driving force for telephone installation has become user demand. India has a current teledensity of less than three percent with a population that includes over 100 million English speaking educated middle class. As India emerges from a legacy of a centrally planned economy it is positioning itself to become the world leader in Internet and multimedia applications and the imperative to install a telecommunications network commeasure with this force is immense.

China remains a centrally planned economy and under its five year plans has the stated ambition to become a fully industrialised nation. The Central Planning Commission is at pains to achieve this while keeping control of economic and political objectives. In contrast to India, user demands are not the driving force, rather central policy objectives.

Malaysia serves as a counter point. Malaysia was the first of the "developing markets" in Asia to embrace market force economic principles and open up its telecom sector. However, it took this path without a sophisticated regulatory framework in place and has suffered from having too many players in a relatively small market. And, as witnessed by the currency and stock market turmoil which characterised the last half of 1997, Malaysia is less able to isolate

India - user demand opens the market

India has the distinction of having one of the few administrations brought to power because of telecommunication issues. The present United Front government won office in 1996 after a campaign in which it accused the previous Rao-led Congress government of corruption, specifically in the licensing of private consortia to run telecommunication services in competition with the government-owned Department of Telecommunications. Rao's communications minister, Sukh Ram, was arrested after the election when he failed to account for $US1.5 million in cash found in his house. Rao himself has been charged with receiving bribes.

Rao was required to open the Indian infrastructure market to foreign participation after India was close to defaulting to international loans in 1991. Subsequently the telecom market was opened in 1994 with the National Telecom Policy (NTP), which set out a programme for the introduction of competition to DoT in 21 zones, which approximately correspond to state boundaries (called circles) throughout India.

Under this programme, private companies (P-telcos) would be allowed to bid for 21 15 year licences to build and operate fixed line local services and/or 42 15 year licences to build and operate mobile telephony services in these same circles. The P-telcos are allowed to include foreign investors, as long as the company remains majority Indian owned. However, through creative company structures, this can mean a consortium can have as little as 13 percent Indian equity.

Under the NTP, the auctions to determine the licensees were to be held under the authority of the Telecommunications Regulatory Authority of India (TRAI). However, government delays meant that TRAI was not mandated until 1997, after the tenders for both fixed line and cellular licences were closed.

Unrealistically high bids were entered in which few foreign telecommunication companies participated. Only two out of 21 potential licences for fixed line services have so far been awarded, although letters of intent have been issued for a further 12 circles. 34 licences have been awarded for cellular services in the same 21 circles.

The new United Front coalition government, with Beni Prasad Verma as communications minister, has made the process of bidding for licences and equipment tenders more transparent. The government says that the telecommunications sector is a priority sector and has budgeted large expenditures for infrastructure upgrades in the expectation that foreign capital will be directed away from China where there is still an official ban on non-Chinese owning and operating networks.

The comparison to the China market is often used in India and commentators point out that India has a similar population base of near one billion with a lower teledensity at one line per hundred people. But in contrast, India has a legal and political system based on the Western model, an English speaking middle class of around 100 million and a rigorously democratic government. And India has moved away from a centrally planned economy and encourages foreign participation in infrastructure projects.

The question then arises, how will the Indian telecom sector develop from here? Will it continue to be driven by IMF demands, or pressure to address corruption? Or will the driving force be user demand from the burgeoning Internet and multimedia industry?

India's government says that it needs some $US66.5 billion in the five years to 2002 in order to provide telephones on demand. This calls for DoT to install 47 million lines and P-telcos to install 20.4 million lines. Funding will come from the retender of basic services licences, the corporatisation and sale of DoT by 1999, and through revenue raised from line installation.

Are these objectives realistic? The growth of the Internet and multimedia applications suggest that Indian users are uniquely placed to exert tremendous pressure on its telecom industry to meet these objectives.

Consider the driving forces behind the Internet and multimedia: programming ability, English language skills (because the Internet is still very much an English media) and original content.

India currently writes approximately 15 percent of global corporate software, a percentage which will have grown to 25 percent by 2002. India has the most number of English speakers on earth. India has a diverse culture which encourages freedom of thought. A culture which also created the world's largest film industry in Mumbai - Bollywood - which, through the pressure of satellite television, is being turned into a world centre for the production of television advertisements, at a fraction of the cost in western countries.

And India is a democracy, which prides itself in this tradition. This in itself gives user demand far more potency than centrally planned administrations in which state benefit is given as a priority over end user benefit.

India is one of the few countries in the region that has not attempted to control the Internet.

China - internal financing against foreign borrowings

Drawing the comparison now the other way, China continues to debate whether if can fund its huge telecommunications rollout plans without direct foreign investment. Does the opening of markets necessarily lead to domination of a sector by those foreign investors?

Pekka Tarjanne, secretary general of the ITU, entered the long running discussion when he told Asia Telecom '97 that China was an example of one of the world's most dynamic telecommunication's sectors that was achieving extraordinary growth without direct foreign ownership. Tarjanne said that in contrast to Latin American or African countries, where new telecom operators tended to be majority owned by foreigners, Asia - and specifically China - had an idiosyncratic approach, "which it seems is paying off", he said.

Tarjanne's comments reflect those of China watchers who dismiss the argument that, given the development demands of the Ministry of Posts and Telecommunication (MPT) which has called for Y600 billion ($US75b) to be invested in the sector over the next five years, China can not avoid opening to foreign investment.

At PTC '97, Hong Kong-based academic John Ure said that it is simply not valid to say that China would not find these funds itself. Ure said that, according to the current five year plan, China will have 170 million subscribers on its PSTN by 2000 with 123 million telephones. However, Ure argued every five year projection has been short and the number of installed lines had consistently outperformed forward projections.

Figures released by the MPT in July help demonstrate the point. The MPT said that the combined (telecom & posts) sector had a turnover of Y81 billion ($US10b) for the first half of 1997, a 33 percent rise from the same period in 1996. In the six month period there were 5.7 million telephone lines added to the national network which is expected to reach 100 million lines by August. The MPT also added 11.3 million telephone users during the period, 9.7 million of which were mobile telephone subscribers. From these growth figures it is clear the five year plan target of 123 million telephones will be well surpassed.

In 1994, 42 percent of MPT's revenue came from installation fees, 34 percent, or $US3.9b, from international and long distance traffic while foreign government loans and investment accounted for 17 percent. Six percent came from domestic loans and one percent from China's state budget.

An employee of China's State Planning Commission (SPC) argued in *Telenews Asia* that second carrier China Unicom's (Lian Tong) entry as a competitor to China Telecom will lead inevitably to an increase in foreign involvement in telecommunication projects. The argument centres on the shrinking indigenous capital base, the competing need for that capital and the need for each carrier to differentiate itself in the market.

In the absence of specialised telecommunications legislation, foreign involvement in the sector has been defined by the Chinese government and its regulators. This means that "the involvement of foreign investors in the operations of telecom services is actually judged on a case-to-case basis rather than a total ban", according to a highly placed official in the Ministry of Posts and Telecommunications (MPT). Sources cited the example of Singapore Telecom's relationship with Lian Tong in running GSM networks, notably in Suzhou.

In the past 17 years, the foreign investment ban on the operations of the telecom industry has been circumvented by either the import of foreign technology or the use of foreign capital for telecom equipment manufacturing. However, in the current transition towards a market economy, the telecom industry faces the critical challenge of trying to compete in a deregulated and highly competitive global market.

It is foreseen by many government insiders that although China Telecom will still be mainly responsible for capacity growth and technology upgrades, only through a transition from a bureaucratically administered basic service to a responsive commercial organisation will the Chinese telecom industry be qualified to compete in the global market in the next century.

The government has signalled its awareness of this circumstance with the corporatisation of the Directorate General of Telecommunications and the establishment of Lian Tong as a competitor in 1993.

A shift of operating mechanism needs the management expertise gained from a foreign partner as a stakeholder. There is an increasing concern within the government that an inability to transform the industry into a commercially efficient entity will unavoidably reduce the fear of foreign domination to a second priority. As a result, it will not be long before the Chinese government has to reconsider opening the operation of telecommunications for foreign involvement, for example by allowing foreigners to form joint ventures.

Lian Tong's entry has dramatically changed the structure of China's telecom industry because of the emergence of competition against a government monopoly.

China Telecom's funding problems are a feature of this new competitive environment. According to the ninth five-year plan, a total of Y500 billion ($US62.5b) should be invested in the sector in fixed assets in order to reach total phone exchange capacity of 170 million by 2000. In 1994, MPT planned investment of Y80 billion ($US10b) to increase telephone exchange lines by 14 million. To achieve this goal Y600 billion ($US75b) has to be invested in the next five years, which means that the fixed asset investment has to grow at 50 percent per year.

However, due to the increased competition driven by foreign participation, it is estimated that the revenue in the ninth five-year plan will only increase at an annual rate of 20 percent. Even if subscribers' contributions maintain the current level, ie 50 percent of the total cost, (informed sources say that this level will drop considerably) the rate of increase of MPT's outsourced funds will be 80 percent.

As a result, the industry will have an even stronger incentive to utilise foreign investment in the next five years in order to reach its goals. In addition to funding problems, Lian Tong's incentive to differentiate itself from China Telecom in the marketplace - and China Telecom will also need to differentiate itself from Lian Tong - will be heightened. As a consequence, both carriers have strong incentives to cooperate with foreign partners more than had the MPT in the previous monopoly.

It may be argued that if the current regulation remains unchanged this will not be possible. However Lian Tong has shown that rules can be broken and the need to stay competitive will likely encourage both carriers to seek further foreign assistance.

However, two recent events seem to diminish this argument and support Ure's view that the State Council is in no hurry to alter its present policy. Firstly, in May the State Council ruled that the MPT would maintain its monopoly over international traffic, effectively freezing Lian Tong out of the lucrative trade. Lian Tong had sought to gain international carrier status in order to finance the buildout of its own alternative network infrastructure.

Secondly, the machinations surrounding Britain's Cable & Wireless selling down its interest in Hongkong Telecom have further sidelined Lian Tong, which had been widely tipped to take a strategic stake prior to Britain's pullout from Hong Kong. The move by MPT aligned companies to take the crucial stake appear to have further limited Lian Tong's ability to differentiate itself and signalled that the Chinese government has no intention of relinquishing control over an industry which is expanding faster than expected, and without direct foreign equity participation.

Malaysia - deregulation without due consideration

Malaysia provides a contrast to the mega Asian economies because it is a small country and its political model may be said to be half way between India's rigorous democracy and China's one party system.

Malaysia has a somewhat sycophantic press and a modern history of inter-racial violence and, although it has a Westminster-based parliament, political debate is severely limited in the name of maintaining sectarian harmony. The political model in Malaysia may be best described as consensual, rather than adversarial.

This has both advantages and drawbacks for a developing economy. On the one hand, the control on political debate allows single minded leadership, as has undoubtedly been demonstrated by the feisty Prime Minister, Dr Mahathir. Mahathir was responsible for making

Malaysia the first Asian country to introduce telecom reforms and open its market to foreign investment. Furthermore, Mahathir has aggressively courted international business to create a future telecommunications and information technology hub.

However, the very means that created these circumstances has also created problems for Malaysia. There has been the tendency to ride roughshod over detail in the quest to reach a national goal and the Prime Minister's personality has all too often taken centre stage and diminished foreign confidence in the Malaysian market, as witnessed by his unsubstantiated claims during October that a Jewish conspiracy was behind the run on Malaysia's currency (following the fall of regional currencies after Thailand's baht was floated against the US dollar on 2 July).

Despite these drawbacks - and the undoubted slowing effect on telephone line rollouts following the run on regional stockmarkets and currencies - Malaysia is achieving its goals.

In June Mahathir took leave from office so he could devote time to marketing his pet project, the Multimedia Super Corridor (MSC), a 15 by 50 kilometre tax free zone extending south of Kuala Lumper and incorporating Malaysia's new capital city, Putrajaya, a new international airport which he claims will be the world's largest airport when complete, and Cyberjaya, a so-called intelligent city.

Mahathir has aggressively marketed the MSC to bring attention to Malaysia's economic achievements, of near 10 percent per annum growth rates, and to steal the march on regional competitors, notably Singapore and Taiwan, in the establishment of a regional information technology hub. Mahathir's tactic has paid off on two counts. Firstly, Mahathir has managed to attract commitments from such diverse companies as Japan's NTT, IBM, Microsoft, Sun Microsystems and Ericsson to have a presence in the MSC.

However, there has been little indication as to the form of these multinational commitments. The vagueness of their involvement is matched by the vagueness of the government and its agency, the Multimedia Development Corporation, as to how the MSC is being funded. The only clear announcement concerned NTT partnering Telekom Malaysia to build a 2.5 Gbits/sec fibre optic backbone with ATM switching.

The second result of Mahathir's relentless marketing has been to push the issue of a stalled telecom liberalisation process into the political background. A telecommunications masterplan was due to be released in 1996 which was to clarify, amongst other issues, equal access rights, the optimum number of licensed carriers and universal service obligation.

Each of these issues has been surrounded in a degree of confusion as a result of the breakneck speed by which liberalisation was introduced into the Malaysian market. Mahathir was perhaps the first regional leader to recognise the economic opportunities of a liberalised telecom sector and he expedited deregulation: first with the 1987 privatisation and breakup of Jabatan Telekom Malaysia (JTM) into Syarikat Telekom Malaysia (STM, or more commonly referred to as Telekom Malaysia Berhad, or TMB) as an operator and JTM as a regulator; and second with the 1994 National Telecommunications Plan (NTP), which saw the sale of 33 percent of TMB, and the licensing of eight more carriers.

In 1995 Mahathir acknowledged that the sector had been opened too quickly and

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said that the government would issue no further licences until a rationalisation took place. There followed a period of intense lobbying in which Telekom Malaysia, Celcom, and Binariang were widely expected to retain their licences and Time, Mutiara, Sapura, Mobikom, Telekom Wireless, and Malaysian Resources Corp Bhd (MRCB), were expected to either sell off their assets or merge with one of the other three companies.

However, after Swiss Telecom invested $US285 million in Mutiara and Deutsche Telekom invested $US560 million in Technology Resources Industries (TRI), a subsidiary of Celcom, the communications minister, Leo Moggie, said that the government would honour all nine licences and that it would be the carriers own responsibility to rationalise.

Subsequently, Telekom Malaysia bought MRCB and Time Engineering bought Sapura to form Time Telekom. However, most analysts say that there are still too many players for a small market and that it is likely further takeovers will take place once equal access is granted and all players are competing on a level playing field.

However, all the carriers waiting to take on Telekom Malaysia are anxious to learn what that playing field will look like. Time, Binariang and Mutiara have all expressed frustration that their long term business plans are in limbo until the masterplan is released, or JTM clarifies some of these issues. JTM refuses to comment and is notoriously difficult to contact. Even a Telekom Malaysia official confided to the author that she finds JTM "unhelpful". However, her comments were qualified with the remark that JTM is waiting for government direction.

During 1997 the Multimedia Convergence Bill, which includes guidelines for telecom regulation, was suppose to provide this direction. During November the communications minister, Leo Moggie, was quoted by the government newsagency Bernama saying that there was no longer any reason to separate communications into telecommunications, broadcasting and computing in terms of technology development. "Therefore the question is, should it not therefore be that these subjects are covered under one legal framework rather than too many legal frameworks?" he asked.

Moggie said that a common regulatory body would be established to ensure the smooth running of the Convergence Act upon its passage by Parliament. "The (Convergence) Act can only cover a very general form including the legal context, but the day-to-day management and operation of such a convergence will need to be undertaken by an organisation which should have some independence in the way it operates," he said.

Moggie said it may not be time yet for the regulator to be fully autonomous. "We are thinking of somewhere in between where the government has some say in it but at the same time leaving a lot of the day-to-day decision making to the body," he said. "That is why we in this country are actively drafting the so-called Multimedia Convergence Act which is intended to provide a legal and regulatory framework that would guide the industry in the future," said Moggie.

However, one week later Moggie said that the Convergence bill will be deferred because there were too many bills to be tabled at the moment. It is difficult to escape the conclusion that, again, the balancing of the demands of many players in a small market has forced the regulatory framework back to the "too hard basket".

Conclusion

At the outset I asked whether telecom de-monopolisation, deregulation and liberalisation will be encouraged in Asian economies through user demand, reluctantly agreed to by governments because of international trade threats, or accepted as the only means for national development?

In each case study a blend of history, social and political consciousness has created a unique market with forces that need to be individually understood by foreign investors. Despite these differences, India, China and Malaysia have the common theme that their telecommunication sectors have been identified as the principle means for achieving national development.

Each country has taken a different route to realise the potential through varied forms of deregulation. Malaysia opened its market quickly and now finds itself looking for new regulatory principles; India has committed itself to a slow deregulation process which is being hastened by increasing user demand; and China appears to reluctantly open small segments of its sector when it finds it has no choice.

A conclusion about the form of deregulation in these three markets over the next five years, and what this means for foreign investors, must be speculative. India's growing international economic relevance and the deregulation process will lead to increasing foreign investment opportunities. China's push to enter international trade organisations will lead to deregulation, however, whether this means an increase in opportunities for foreign investors must be considered against a history of complaint from many investors that it is difficult to realise promised returns. Malaysia wants to be the hub by which foreign investors control their regional business. If the government manages to unravel the intricacies of a regulatory framework then this goal is achievable.

A Changing Regulatory Framework for a Changing Telecommunications Landscape

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1.0 ABSTRACT:

This paper explores the effects on the strategic choices and performance of a number of telecommunications organizations which have undergone deregulation. A regulatory framework has been developed which suggests that regulatory reach and regulatory incrementalism influence strategic choice and performance. This framework was empirically examined using a path analytic model.

2.0 INTRODUCTION:

The telecommunications industry is undergoing dynamic and dramatic change such as globalization and deregulation which is transforming the global landscape of the industry. These changes are being driven by the convergence of telecommunications, data processing, broadcasting and multimedia industries leading to the emergence of information highways (Tarjanne, 1995). This global trend towards deregulation of the telecommunications industry heightens the need to empirically study the intersection between deregulation, strategic choice and performance (Miller, 1994; Chandy,1995).

Though the literature on privatization and liberalization is extensive, it however lacks a comprehensive detailed description of the deregulation of the telecommunications industry (Miller, 1994). The literature does not provide a viable strategic model which could be used to guide governments to transform their state-owned Telecom. Operators into privately owned and competitive enterprises.

Many vital questions remain un-addressed, such as:

1. What regulatory framework to apply in a dynamically changing industry landscape?
2. How does deregulation affect strategic choice?
3. Do Telecom. Operators pursue riskier strategies under regulation or under deregulation?

3.0 DEREGULATORY FRAMEWORK:

In the Deregulatory framework tested in this research, government regulation and deregulation are expected to affect strategic choices which in turn are expected to affect performance as measured in financial terms and risk (Reger, Duhaime and Stimpert, 1992).

Both direct as well as indirect effects of the environment were examined. Indirect effects of deregulation on performance and risk may occur due to the mediating effects of strategic choices. At the same time the performance and risk of organizations in a industry can be influenced directly and indirectly by regulatory activity. The possibility that regulatory scope and incrementalism may have both direct and indirect effects on performance and risk were incorporated into the framework.

4.0 DEREGULATORY DIMENSIONS:

There are basically two types of regulation:

1. Social Regulation which tends to regulate non-economic activities.
2. Economic Regulation which tends to be directed towards the competitive dynamics of an industry.

Economic regulation has global implications as many countries use such regulations to constrain competition in various markets in order to protect national firms. As such this research focussed on competition- constraining regulation.

According to Reger et al (1992) the purpose or type of regulation however does not capture the extent of influence of regulation on strategic choice and performance. The ***REACH OF REGULATION*** more fully reflects the depth of deregulation, which encompasses both the scope and the stringency of regulation

Mahon and Murray (1981) have suggested that when examining regulatory effects at the organizational level, the rate of deregulation must be taken into account. This is because organizations may have time to adjust their capital expenditure in anticipation of the environmental changes to come. This has been encompassed in the ***REGULATORY INCREMENTALISM*** dimension which is a process similar in nature to Quinn's (1980) concept of logical incrementalism.

The framework thus encompassed two dimensions of regulation :

1. Regulatory Reach
2. Regulatory Incrementalism.

4.1 REGULATORY REACH (REACH):

The telecommunications industry faces regulations which generally tend to constrain Telecom. Operators from engaging in certain activities. These regualtions have tended to be social in nature in order to protect the interests of the consumer and to protect the interests of the state, which is the "shareholder".

Even a superficial knowledge of the Telecommunications industry suggests that easing of restrictions will provide unequal strategic choice opportunities and impact performance differentially.

A regulatory reach index was developed to measure the extent of regulation present in the sample countries and to reflect the differential impacts of regulations.
Regulations for each country were coded in the following manner:
For National Telecommunications : 7= national limited-liberalization , 6 = national full liberalization.
For Intra-regional : 5= regional non-reciprocal, 4= regional reciprocal, 0= not permitted.
For Global Operating companies: 3= unlimited access, 2= limited access, 0= not permitted.

The REACH of regulation index was then calculated as a sum of the values for the national, intra-regional and global companies. The greater the level of deregulation, the higher the values of REACH assigned to that country. This index does have some limitations but it was felt that it captures the differential effects of deregulation in a way which prior studies have not been able to achieve.

4.2 REGULATORY INCREMENTALISM (THETA):

The rate and speed of regulatory change (incrementalism) varies from country to country. For instance, the countries that provide the most stable regulatory environments have made no changes to the laws relating to their telecommunications industry in the past ten years. On the other hand some countries are rapidly deregulating their telecommunications industry in one or two sweeping legislative changes while other countries are gradually implementing liberalization policies. The slower the rate of change would allow incumbent Telecom. Operators with more opportunities to adjust their strategies, thereby resulting in higher profits and less risk.

In constructing an index to measure regulatory incrementalism, information gathered through telephone interviews, mail surveys and literature search was used to calculate the number of changes (THETA) in the five years prior to 1995. Higher the number of changes, faster the level of incrementalism.

The *regulatory reach* and *incremetalism* variables capture different aspects of deregulation. *Reach* is a measure of the absolute level of deregulation in a country at a given point in time whereas *incrementalism* measures the rate of change in regulation over a given period. It is possible that these variables may co-vary, as such the correlation coefficients were examined before using them concurrently in the path analytic model.

4.3 STRATEGIC CHOICE VARIABLES:

The literature offers a plethora of strategic choice variables (Reger et al, 1992). It is difficult to include all the strategic choice variables in one empirical study. Hence in this study it was deemed crucial to include strategic choice variables which the literature and an industry analysis suggested would be influenced by deregulation and which would also have an impact on the performance outcomes. The strategic choice dimensions used in this study were service/ product provisioning mix, geographic and product diversification.

In addition to the importance of these dimensions in the strategic management field, they are of high significance in the deregulation of the telecommunications industry and as such they are especially relevant to this study.

The key service/ product provisioning mix decision in the telecommunications industry is whether to focus on the provisioning of residential services and/ or concentrate on the business oriented services (Vallance, 1995). It is tempting to divide all telecommunications activity into provisioning of residential or business services. The Telecommunications industry literature and Industry experts however suggest that other major services such as mobile services, provisioning of customer premises equipment (CPE) and value added services (VAS) are also relevant.

Two types of diversification based on the industry's history were deemed to be important: globalization and the traditional service/market diversification. GLOBINV is measure of a Telecom. Operator's diversification outside its country's borders whereas NONTELINV measures the extent of diversification into non-traditional telecommunications activities such as broadcasting. The measurements used for GLOBINV was the ratio of investment in other telecommunications projects/organizations to total l investment. For NONTELINV the ratio of investment in non-telcom. related activities to total investment was used as a measure.

4.4 PERFORMANCE DIMENSIONS:

Where regulation prohibits excessive competition, higher profit levels are expected as a result of the favorable industry structure (Porter, 1980; Scherer, 1980). Regulatory effects on performance in previous studies have tended to be defined in terms of financial performance. As most organizations included in the sample are still state-owned enterprises, it is not possible to use market based performance measures such as earnings per share or P/E ratio. Financial performance was therefore measured in terms of return - on - assets (ROA), as data on this was readily available. Furthermore Reger et al (1992), have pointed out that the ROA tends to be a measure that is closely watched by industry analysts and organizations themselves.

However profitability is not the only component of organizational performance. The degree of risk an organization is willing to take in order to achieve a certain level of profit is another component of organizational performance (Bettis and Hall, 1982). Risk needs to be considered when studying regulatory impacts because regulation/deregulation tends to limit strategic options which in turn can distort risk profiles. This is because deregulation opens up new opportunities and some organizations may seek to actively manage risk as well as financial performance (Reger et al, 1992).

One of the risks that a Telecom. Operator is exposed to is the asset management risk, that is, the rate of asset utilization. One way in which this can be measured is by the ratio of inactive subscribers to total subscribers. As this is an area of risk that Telecom. Operators actively seek to manage, it was deemed the most appropriate measure of risk in this study. Also data on this is widely available. This variable was labeled TELECOM RISK.

5.0 RESEARCH DESIGN AND HYPOTHESIS:

There is a global trend towards deregulation of telecommunications, which is creating a variety of regulatory environments. This trend towards greater deregulation is gaining momentum and as such provides an interesting and exciting area for research.

[Insert Figure 1]

Figure 1 presents the framework with the hypothesized relationships as being either positive or negative.

6.0 METHODOLOGY:

The sample for this study consists of Telecom. Operators in countries which deregulated their telecommunications activities prior to 1995. This identified 34 countries. In order to reduce the possible distortions arising from size variation in the population, the study is limited to medium to large telecom. Operators - those with $500 million or more in assets. This resulted in a sample of 112 Telecom. Operators ranging in size from $50 million to $51,250 million with a mean of $11,325 million in total assets.

6.1 DATA COLLECTION:

Due to the geographic distribution of the countries, it was decided that the most cost-effective method of collecting data would be initially through a mail survey. Mail surveys were sent out to the regulatory bodies responsible for the telecommunications sector in the 34 countries in late 1994. Responses were received from 18 countries given a response rate of 53%. Another survey was sent out in the middle of 1995, which was followed two weeks later by a telephone contact, increasing the response rate to 85%.

In the second phase of the data collection, the regulatory bodies who responded were contacted by telephone during 1995 in order to clarify some of the answers given in the mail survey and to ask for any updates since the mail survey.

The regulatory variables were then matched with the strategic choice and performance data for 1995, the latest available data.

7.0 RESULTS:

The correlation analysis shows that there is moderate correlation between REACH and THETA which suggests that these variables captured different but related aspects of regulation and are within acceptable levels. These findings support similar findings by Reger et al (1992).

The hypothesized framework illustrated in Figure 1, was tested by developing a the Path Analysis technique. A path-analytic model is an ideal way to assess direct and indirect interactions (James, Mulaik and Brett, 1982).

[Insert Figure 2 here]

The results of the final path model shown in Figure 2, support some of the hypothesized relationships illustrated in Figure 1. The results show that REACH and THETA have both direct and indirect influences on TELECOM. RISK and ROA. Also the strength of the direct effects is greater than that of the indirect effects. REACH has negative direct and indirect influences on both TELECOM. RISK and ROA, whereas THETA has positive direct and negative indirect effect on ROA and a negative direct and a positive indirect effect on TELECOM. RISK.

REACH also influences strategic choices regarding Residential, Mobile, Global Investment and Non-Telecom. Investment. THETA influenced only choices regarding Residential and Global Investment. The strategic choices Business, Value-added Services, Global Investment and Non-Telecom. Investment influenced TELECOM RISK but not ROA. Provisioning of Customer Premises Equipment (CPE) has a negative influence on TELEOCM RISK while TELECOM RISK exerts a positive influence on ROA.

8.0 DISCUSSION:

The results of the final path model suggest that the influence of deregulation on strategic choice and performance is more complex but significant for risk and performance. The results are not only statistically significant but are of prime importance to both the telecommunications regulatory bodies as well as Telecom. Operators operating or about to operate in a deregulated environment.

The findings that deregulation has both direct as well as indirect influences on TELECOM RISK and ROA suggests that deregulation will increase rivalry and entry of new players, and this will lower ROA. The positive relationship between ROA and TELECOM RISK however provides incentives for Telecom. Operators to accept higher levels of risk under deregulation in order to maintain profitability at or above the levels obtained under regulation. The results show that REACH and THETA are negatively associated with TELECOM RISK, indicating that Telecom. Operators in the sample are reluctant to choose this option. Some Telcom. Operators might be tempted by the opportunity to maintain profits through increased risk, which maybe attractive to managers whose rewards are based on short-term financial performance. Telecom. Organizations and Policy makers should therefore be aware of the impact of incentives when formulating strategies for operating under a deregulated environment.

The results show a positive influence of THETA on ROA, indicating that a gradual (incremental) shift towards deregulation provides Telecom. Operators opportunities for adjusting to the changing regulatory environment. Similarly THETA is negatively associated with TELECOM RISK - here again incrementalism allows Telecom. Operators time to adopt less riskier strategies. The general findings indicate that deregulation is least disruptive when changes occur incrementally providing affected organizations advance notifications of the impending changes.

The negative relationship between REACH and TELECOM RISK suggests that deregulation either provides opportunities for Telecom. Operators to better manage risk they assume or it removes incentives for excessive risk-taking present under regulation. From the data it appears that deregulation provides Telecom. Operators with opportunities to adopt new strategies which are less risky than strategies which are tied to the vagaries of a particular geographic region.

While deregulation influences strategic choice, the impact is less than expected. REACH influences choices regarding Residential, Mobile, Global Investment and Non-Telecom. Investment, but for three of these choices the relationship is only moderately significant. THETA influences only Customer Premises Equipment (CPE) and Value Added Services (VAS), suggesting that regulatory incrementalism leads Telecom. Operators to reduce the proportion of riskier Customer Premises Equipment and Value Added Services.

Significantly the balance between residential and business service provisioning was unaffected by Regulatory Reach or Incrementalism. This finding was unexpected. It may be that other environmental factors not represented in the framework affect this choice.

In addition strategic choice variables which were affected by both Reach and Incrementalism, Value Added Services (VAS) and Customer Premises Equipment (CPE) provisioning constitute smaller portions of the portfolios of most of the Telecom. Operators in the sample. Thus it could be easier for most of the Telecom. Operators to sell these areas of their business in order to change strategies than it would be to exit from, or even significantly reduce Residential or Business services.

Another interesting and unexpected finding was that five(5) out of the seven (7) strategic choice variables influence TELECOM RISK but only one influences ROA directly. One explanation that supports these findings is that, in response to deregulation, Telecom Operators adopt new strategies very quickly as evidenced by the four strategic choice variables significantly influenced by THETA. The immediate impact of these strategies could be to reduce RISK. However other research shows that the successful implementation of new strategies, especially diversification, requires a considerable amount of time and investment to exert a significant influence on performance. This suggests that managers in the Telecommunications industry have taken a cautious approach to deregulation, perhaps they have taken a more long-term view than they have been given credit for.

9.0 IMPLICATIONS AND FUTURE RESEARCH DIRECTIONS:

This study has addressed a number of important issues concerning the relationship between deregulation, strategic choice, risk and performance. As the trend in the Telecommunications Industry is for greater levels deregulation these are pressing issues.

The findings presented in this study if replicated by further empirical research will be of a assistance to telecommunications regulators in formulating regulatory policies. Strategic Planners and Consultants working in the industry should take into account the results when formulating strategic responses to deregulation.

The findings on the relationship between risk and performance lend support to the common sense notion that managers should use caution when responding to deregulation. A fruitful direction for future research could be to consider the potential for Telecom. Organizations to achieve competitive advantage by formulating political strategies toward regulatory agencies.

In spite of the importance of regulation and deregulation, relatively few studies have examined the impact of deregulation on strategy formulation and implementation and subsequent effect on performance. This study contributes to this new stream of research and offers a framework suggesting that *regulatory reach* and *incrementalism* influence organizational strategies and performance. The results suggest that deregulation significantly impacts on strategic choice, risk and performance. These relationships should be further explored in future research as deregulation is increasing in importance.

One future research direction that could be considered is to study how Telecom. Operators are competing across different regulatory environments.

This study is limited in its scope as it examined only two dimensions of deregulation: reach and incrementalism. Other important dimensions may exist that were not incorporated in this research but should be considered in developing a strategic management based deregulatory framework. One area that could be examined is the volatility of deregulation. Regulatory volatility refers to changes in regulatory directions - for instance, first encouraging competition, then restricting competition, then requiring it and so on. Regulatory volatility creates an "undulating playing field". Managers of Telecom. Organizations may find it extremely difficult to develop strategies under these conditions. Thus, it is important to examine in future research the positive and negative effects of volatility.

Future research should also examine the long-term effects of deregulation, such as the time lag effects between regulatory change and strategic response and its impact on performance in order to provide greater insight.

Subsequent research might also examine other variables not included in this study. The role of managers in perceiving, framing and reacting to deregulation is promising. For instance, how managers assess the opportunities and threats posed by deregulation and how managerial interpretation and framing of the environmental discontinuity moderates the relationship between deregulation and strategic choice should be researched further.

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REFERENCES:

Bettis, R. and W. Hall (1982), "Diversification strategy, accounting determined risk and accounting determined returns", *Academy of Management Journal*, 25, pp254-264

Chandy, T. (1995), "Deregulation and Technological change: Telecommunications in the US and UK (1948-1983)", *Proceedings of the Fifth Annual Bayer International Conference*, pp 68-71.

James, L.R., S.A. Mulaik and J.M. Brett, *Causal Analysis: Assumptions, models and Data*, Sage, Beverly Hills, CA, 1982.

Mahon,J.F. and E.A. Murray (1981), "Strategic Planning for regulated companies", *Strategic Management Journal*, 2, pp251-262

Miller, A. (1994), "Privatization: Lessons from the British Experience", *Long Range Planning*, 27, pp125-136

Porter, M.E., *Competitive Strategy*, The Free Press ,New York, 1980.

Quinn,J.B., *Strategies for change: Logical Incrementalism*, Irwin, Homewood, IL, 1980.

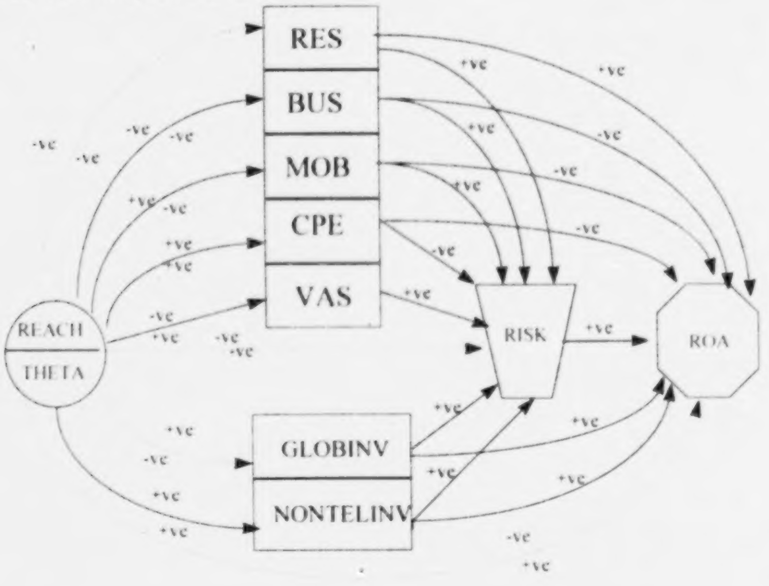
Reger, R.K., I.M. Duhaime and J.L. Stimpert (1992), "Deregulation, choice, risk and performance", *Strategic Management Journal*, 13(3), pp189-204.

Scherer, F.M., *Industrial Market Structure and Economic Performance*, Rand, McNally College Publishing Company. Chicago, IL, 1980.

Tarjanne Pekka, "Breaking down barriers towards the global information society", *Strategies Summit, Vol.1*, Telecom 95 Conference, Geneva, 1995.

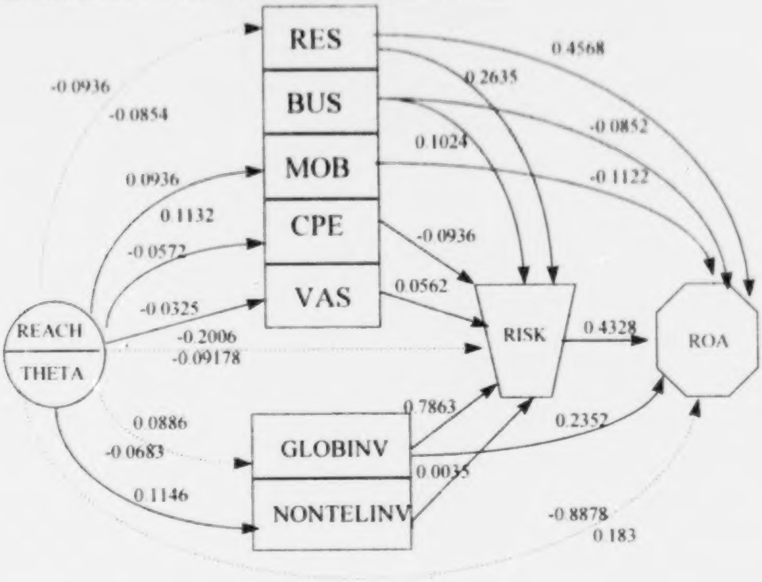
Vallance, Sir Ian, "Regulatory Convergence towards the Information Society", *Strategies Summit - Vol.1*,Telecom '95 Conference, Geneva, 1995

FIGURE 1 DEREGULATORY FRAMEWORK



NOTE: A broken line indicates two paths, with relationships for REACH above the line and for THETA below the line.

FIGURE 2: FINAL RESULTS FROM THE PATH ANALYSIS MODEL


RES
BUS
MOB
CPE
VAS
REACH
THETA
RISK
ROA
GLOBINV
NONTELINV
-0.0936
-0.0854
0.0936
0.1132
-0.0572
-0.0325
-0.2006
-0.09178
0.0886
-0.0683
0.1146
0.4568
0.2635
0.1024
-0.0852
-0.1122
-0.0936
0.0562
0.4328
0.7863
0.2352
0.0035
-0.8878
0.183

NOTE: A broken line indicates two paths, with relationships for REACH above the line and for THETA below the line.

Coping with Telecommunications Policy Change in Southeast Asia

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ABSTRACT

The development needs of each ASEAN country has led to a different set of priorities in establishing new policy regimes suitable to each country's unique political and social condition. An assessment of telecommunication policy based on development needs and priorities of the ASEAN countries reveals country and regional changes mitigated primarily by internal country motivations. As such, an evaluation of telecommunication policies of each country of ASEAN in the late 1990's and into the next century is made based on development priorities in that country. Bearing in mind as well the role of exterior forces, such as regional and international fora as well as technological and market externalities, gives added scope for policy change.

I. INTRODUCTION - ASEAN Ten Minus One

The evolution of telecommunications structures and regulation in developed nations may very well be beginning to focus on issues of technological convergence. However, Southeast Asia has for the past decade formed its own unique blends of development tracks with regards to changes in industry competition, policy and market liberalization as well as privatization of state enterprises to some degree. The perceived development needs of each ASEAN country has led to a different set of priorities in establishing new regimes of regulation suitable to each country's unique political and social condition. This policy evolution, while transforming the telecommunication landscape of ASEAN as a whole, is nonetheless still primarily concerned with providing basic services as well as taking advantage of new mobile and satellite services to supplement and in some cases supersede basic wireline service. In this regard, the regulatory evolution of each ASEAN country is taking on perhaps similar themes, but, the paths of implementation are divergent.

So too the political divergence in ASEAN and hence a divergence of development priorities. While the grouping had intentions of expanding to all ten countries of Southeast Asia in mid-1997, a political turn of events in early July 1997 has delayed the accession of Cambodia to full membership. Nonetheless, the ASEAN grouping now includes nine countries with the addition of Laos and Myanmar as full members in July 1997. From a dictatorial military regime in Myanmar and an absolute monarchy in Brunei, to the evolution of open, multi-party democratic processes in Thailand and the Philippines, ASEAN represents a complex mix of varying degrees of authoritarian and democratic politics. Development priorities can shift quickly and as often as governments change in some countries while a glacial evolutionary process takes place in other countries with entrenched systems. Yet others attempt to be nimble and competitive, valuing economic reason and social cohesiveness to more liberal political freedoms as a cornerstone to development policy. And all of this with the cherished, if sometimes not altogether consistent notion of non-interference in each other's internal affairs known in ASEAN parlance as 'constructive engagement.'

With such diversity, is it reasonable or even possible to talk of ASEAN telecommunications policies as a single unit? While the specific cases of each country warrant separate attention and understanding, especially in terms of development priorities, more recently, the shift in telecommunications policies in each of the countries of ASEAN is beginning to evolve, at varying speeds, toward a more converged position. This is can be seen, in part, as a result of the influence of goal-oriented agreements among the ASEAN countries such as the Asian Free Trade Area (AFTA), participation of several ASEAN economies in the Asia-Pacific Economic Cooperation (APEC) forum, membership of several ASEAN countries in the World Trade Organisation (WTO), as well as the evolution and expansion of regional "growth-triangles" [1], which combined are edging each separate country to begin to conform to common economic and trade liberalization goals. Also within ASEAN more recently is the idea of developing a regional "free investment area" by 2020. Such emphasis on commonalty in markets and further trade liberalization measures have the effect of beginning to shape policies of each country toward a common base in regulation of its telecommunications industries as well.

It remains to be seen if the added diplomatic strain of the now nine-member ASEAN, with one potential member still left out for now, can continue with positive initiatives and timely implementation in its many committees. On a positive note, however, was the formation in 1994 of the ASEAN Telecommunication Regulators' Council (ATRC). The Council has, as part of its agenda, the formation of ASEAN consensus views vis-a-vis international organisation such as the ITU and APT. The ATRC is not a formal mechanism of ASEAN and is not responsible to the ASEAN Secretariat. Rather, it is organised with the intent to form a common ASEAN position, where possible, in matters of technical harmonisation and to foster practical coordination and cooperation in common telecommunication issues. Currently, major issues under discussion by the ATRC include harmonising the type approval process and the build-up of broadband networks, promoting interconnection, developing human resources expertise, as well as trying to find common positions on the demands of recent developments in accounting rates, the international telephone settlement rate system. ASEAN is also committed more recently, through the ATRC, to intensifying cooperation on international issues by joint coordination of a common ASEAN position.

II. ASSESSING ASEAN REGIONAL TELECOMS POLICY

An assessment of current and future potential policies needs to focus on development needs and priorities of each ASEAN country. Development priorities are strikingly different from country to country and reflect more of the internal socio-political realities of each country rather than some aspired ASEAN-wide commonalties.

In addition, internal definitions of development priorities shape significantly the extent to which outside participation is structured and how each country copes with external pressures. This includes participation at the regional as well as global levels. In the same way, therefore, such internal diversity also means that an entity from one ASEAN country that wishes to do business in another may find similar sets of difficulties to confront as many other entities from countries outside of ASEAN find in dealing with a member country.

Recent research (Ono, 1997) suggests that from the point of view of lesser developed countries, main obstacles to telecommunication development include the factors of inadequate, improper or even inconsequential policy and regulation as well as finance problems and overall country political factors. Beyond Ono's assessment, the degree to which such factors mask unspoken, even taboo realities of corruption, greed and mismanagement in many lesser developed countries is experientially evident as well. Suggested strategies to overcome these obstacles as pointed out by Ono's research, again from the point of view of less developed countries, include not only gaining access to better information to properly structure policy and regulation but the need for recognized international and regional organisations such as the International Telecommunications Union (ITU) and the Asia-Pacific Telecommunity (APT) to take on a greater role at articulating - even advocating - proper telecommunications policy. This would be with the view toward establishing cooperation with financial institutions and private investors leading to establishing "a solid regulatory body with a sound regulatory framework.[ibid., p.27]" Again the implied message is to establish a largely uncorrupted and enforceable, law-based regulatory regime which is adhered to in as fair a manner as possible without succumbing to individual or institutional selfishness whether from the private or public sector. Where such external cooperative fora have been most effective in influencing telecommunication policy however is not perhaps in the telecommunication organisations themselves, but the international and regional trade organisations. This will be discussed further in the section IV.

In this regard, the policy evolution of each ASEAN country can be placed against benchmarks of self-admitted obstacles and strategies for improvement. As each country takes on similar themes, the manner in which politicians are able to take charge of positive policy objectives in removing obstacles is key to explaining why paths of implementation are divergent from country to country. While perceived development needs and even priorities are laudable in posturing for clearer policy incentives, only through the actual practice of clear and transparent regulatory function can the widest possible development take place to the benefit of most. Only then will the now proverbial "gaps" in telecommunications service provision begin to narrow.

Such basic regulatory and policy foundations can only be established in a reasonably stable political environment and in an arena where both public and private finance is looked upon as a legal and moral social contract by both politicians and industry players. Unfortunately, these preconditions are not met by all ASEAN members at this time. Whether or not these needs are met in the future will depend, to a greater extent, on the manner that each country begins to implement and continues to support a strong, largely uncorrupted, legally enforceable and reasonably transparent policy regime. It is in this regard that the more developed countries of ASEAN must take a lead to "constructively engage" partner nations to achieve and share their successes.

By now, familiar themes of continued privatisation of state-owned telecommunications companies, engendering more private participation in telecommunication markets and the advancement of regulation toward a more liberal scope of opportunity for multiple, competitive players, is in evidence world-wide. Some countries such as Malaysia and Singapore are further along in this policy development arena, while others such as Vietnam, Laos and Myanmar remain firmly entrenched in old-style state-owned PTT monopolies. Yet others such as Thailand and Indonesia, continue to evolve along this inevitable policy development path with fits and starts in selected areas.

The main concern in most ASEAN countries is the structure, expansion and operation of basic voice and data for domestic and international services. That an overlay or extension of such services can be achieved through wireless methods is also important. Even in more advanced Singapore, the build-up of more basic services and infrastructure is a high priority. But for much of ASEAN, simply building reliable basic services to the point where teledensity approaches a more developed status, remains an elusive goal. Despite a plethora of so-called new and converging technologies being introduced to a limited extent in parts of the region, including building broadband networks and ensuring their interconnectivity, development of telecommunication policy still needs to focus on the priority of providing adequate domestic and international basic services.

But, the development of basic services is strikingly different today than it was even ten years ago. State monopolies are increasingly under intense pressure to re-invest more heavily into the expansion of service, which undermines the political position of garnering state-funds for other purposes which have been earned by telecommunications. As these telecommunication entities and governments find it increasingly difficult to self-finance telecommunications development at the level needed and indeed now demanded, the cracks of liberalisation in the sector in terms of investment policy re-alignment begin to appear. Private and government-linked entities outside each country, which see large development potentials and new market opportunities, also add to the pressure toward policy evolution to some extent.

Complicating the picture are those developments outside the immediate control of any one country, but with substantial effects on them. These include shifts in accounting rates (most recently the U.S. Federal Communication Commission decision to unilaterally reduce settlement payments), market access demands, tariffing re-alignments and a host of technologically innovative applications such as call-back services and Internet telephony. Therefore, getting the policy formula correct in the face of an ever changing technological and entrepreneurial assault from outside each country coupled with the increasing demands of growing business and residential needs from within the country for efficient services means that telecommunications is having to become a substantive priority. But determining levels of allowed competition, levels and manner of foreign ownership and participation, as well as implementing transparent investment policies, comes primarily from overall internal development policy guidelines. Only a few ASEAN countries have taken on such development rigour and still fewer have coped with it successfully to date.

III. DEVELOPMENT PRIORITIES AND POLICY CHANGES

More importantly, domestic and international pressures for change must also be seen in the light of continuing efforts to promote development priorities within each country. Sometimes local needs will weigh-in politically if not economically as the rationale to continue with various forms of protectionist measures, be they tariff or non-tariff in nature. This can be due to entrenched unions and civil service, difficulty in getting policies changed and properly implemented in politically volatile situations, entrenched political incumbency unwilling to change, and the general perceived need to politically control, on an exclusive basis, the telecoms "cash cow", an important revenue generator in many countries.

In reality, other major development needs put pressure on state funds to the extent that telecommunications is not seen as a first priority. While such short-sightedness in central governance continues in several Southeast Asian nations, others have begun to see the more enlightened view that telecommunications development has a multiplier effect, both tangible and intangible, that far outweighs its initial investment and the capacity of a closed PTT system to handle.

Nonetheless, placing a priority on efforts at policy reform for the development of plain-old-telephone-service (POTS) is still a major policy hurdle for several in ASEAN to overcome. According to the oft-quoted ITU statistic, we are apparently no closer to getting more people of the world to within 2-hours walking distance of a telephone than we were some 10 years ago. This is indeed bad news and is even worse when set against an ever increasing world population.

The development priorities of each country of ASEAN are indeed different. While all aspire to economic growth on a broad scale, developments toward a more open, market-based economy needed to achieve such growth are taking place at very different rates. Of course each country also places telecommunications, transportation, education, health and so forth at different priority levels. Even within the telecommunications sector itself, development priorities differ. In Indonesia for example, the priorities have been on providing adequate telecommunications facilities and services for the manufacturing, tourism and government sectors while residential services developments are placed at a lower priority. In the Philippines and Thailand, provision and expansion of adequate services for the lucrative private business sector has seen greater attention in actual expansion works.

Such overall internal economic and articulated telecommunication sector development priorities have in fact been better indicators of policy direction and rate of change than many outside pressures. For example, despite intense outside pressure, notably from the United States, Thailand's TOT and CAT have resisted privatisation moves for years. Substantive development priorities within the country coupled with political turmoil has simply meant that any rational move toward major telecommunication policy reform would meet with inaction. However, given this year's financial crisis in Thailand, such changes are being considered as a higher priority.

In all however, the overarching priority of providing adequate basic services, as well as newer technologies and services, are beginning to provide an imperative for yet more structural re-arrangement. This is especially true in Singapore and Malaysia overall as well as selected sectors of industrial development in other ASEAN countries. For example, the initiatives of Singapore for an ASEAN-wide police information exchange system similar to Interpol meets with some difficulties when newer technologies and advance telecommunications systems are inadequate or non-existent in other member countries. Such regional cooperative efforts do add pressure to promote substantive change. Nonetheless, each country must make the priority commitments to change their own policies to help engender such developments and participate more efficiently in such cooperative efforts.

So what are the development priorities of the countries of ASEAN? And how do these priorities affect policy change in the domain of telecommunications? While it is not possible to give a detailed description of all nine ASEAN countries here, the examples of three countries, namely, Vietnam, Indonesia and Malaysia are provided as general examples of countries at low, moderate and more advanced stages, respectively, of development. This is followed by an abridged version of current policy evolutions and potential near future trends in the remaining six ASEAN countries.

3.1 VIETNAM

Vietnam has now seen a decade of progress since the promotion of the "doi moi" (renovation) policy of 1986. In that decade, the American embargo to Vietnam was also lifted giving rise to greater influx of foreign investment as well as seeing much improved trade relations. Vietnam also became a member of ASEAN in 1995 and has been making the effort to integrate into the thinking pattern of the group.

On a macro-economic level, the major changes in Vietnam have been in renovating the economic structure in recognition of the importance of market relations. Three main objectives still permeate development policy in Vietnam. These are, 1) developing agriculture, forestry, fisheries and the rural areas (80% of population), 2) promoting the production of consumer goods, and 3) the export of goods and services through the enlargement of external economic relations.

Nonetheless, Vietnam recognizes is own set of economic sectors as the state sector, the collective sector, the private sector (defined largely as the family or household economy and small private enterprise) and the joint economy of the state sector with others known as the state-capitalist sector. It is largely into the first category of state enterprise that telecommunications falls in Vietnam. Hence development of telecommunications is focused entirely around the state sanctioned enterprises Vietnam Posts and Telecommunications (VNPT) and the Military Electronics Telecommunication Corporation (METC). These enterprises are then allowed to enter joint ventures with other partners, form subsidiaries, as well as form unicorporated joint ventures with foreign investors known as a Business Cooperation Contract (BCC). Australia's Telstra was the first to enter this latter form of agreement in telecommunications development in Vietnam in the late 1980s, although over the years, long-term risk and Vietnam's uncertain environment has dampened its edge.

The changes in Vietnam have been chronicled notably in these PTC proceedings and elsewhere (Petrazzini, 1995; Barlow, 1995; Gilbert 1997; Hudson, 1997). However, each ends with no clear indication for future directions of telecommunications policy change in Vietnam. Given the somewhat arbitrary nature of policy change and the lack of transparency in implementation processes, this is understandable. More recently, Murray (1997) suggests that there remains a reluctance amongst some Vietnamese officials to allow foreigners into the telecommunications sector as it is seen as important to national security. Such attitudes stem largely from the years of foreign "resistance" struggle. This can be seen in the process to secure a BCC which requires approval from the State Committee for Cooperation and Investment in Hanoi. The process to get permission has not been transparent and is largely tied to political links with Hanoi. Telstra's bid for a $1.4b contract in mid-96 failed to materialize even after a year of negotiation. Swedish firm Comvik was recently awarded a telecommunications BCC for a pager and cellular service but only after the visit of the Swedish Prime Minister to Hanoi in mid-97. Singapore Telecommunications International (STI), Steamers Telecommunications (a unit of Keppel Corporation, Singapore) and Shinawatra of Thailand were still in trial-project stages (in Ho Chi Minh City) under the auspices of the Ho Chi Minh City Posts and Telegraphs Department in early 1997. They were, for a time, unable to repatriate profits from investments without the granting of the BCC. That these latter companies were not tied directly through VNPT initially may have contributed to the delay in granting the BCC despite already setting up trial systems.

More importantly, however, one must understand the overall style of economic reform thinking in Vietnam. While ostensibly perched as market-driven reforms, such is always not implemented in what may be regarded as the logic of the West. For instance, the Directorate-General of Posts and Telecommunications (DGPT) has been keen to adopt various market slogans as rhetoric in support of the reform process. For telecommunications, it is recognized that VNPT needs to be more customer-oriented. But since VNPT is viewed as the main customer (buying and implementing technologies) for nearly all telecommunications development, a different meaning is given to the often quoted slogan the "customer is king."

The structure of the joint economy of the state sector is telling in forecasting future change to telecommunications in Vietnam which follows closely changes in other major industrial and service sectors. For now, the major focus of change in policy is on price reform, financial and banking sector reform, revision of monetary policy and the legal sector as well as reorganizing, to some extent, management apparatus. With such development reforms taking place at various speeds and effects, it is relatively easy to see the direction and pace of change to telecommunications. With reform of the previous mentioned areas in progress, it is simply premature to talk of the privatisation of VNPT. Perhaps as the company's business interests expand, corporatisation may be forthcoming in about 5-10 years, if financial and legal structures are in place.

Telecommunications law change has been rather ineffectual in Vietnam as several efforts to form new statutory law have been bogged down in recent years. Instead, the preference still seems to be with issuing sector executive orders and regulation guidelines through the DGPT when necessary. These are in fact in line with the progress of other sector reforms.

Telecommunication sector liberalisation will therefore be very gradual with initially the further development of service area licenses in joint venture with VNPT to expand basic services (with some emphasis on the development of a local wireless loop) to the rural areas as Vietnam attempts to fulfill its stated goals of expanding to 5 million lines by 2000, for a mainline density of six percent. Beyond that, the target is to install an ambitious one million lines per year for 15 years to provide a total of 20 million lines by 2015 for a teledensity of 25%.

How all of this will be financed is not altogether clear. To date, financing has been achieved primarily through supplier credits, international loans and grants, joint ventures and some BCC arrangements in addition to State funds. Given the scope and pace of economic reform and development priorities, it is likely that VNPT revenue will be directly re-invested for telecommunications development and that various revenue sharing shemes will be developed along the lines of the experience in Indonesia andThailand. This will, in time, expand the scope of foreign investment and provide an additional needed boost to technical and managerial expertise despite some misgivings about foreign involvement.

The internal development scenarios and priorities of Vietnam do articulate much about the development direction of the country which can give scope to the direction of telecommunications policy and how Vietnam will cope with change. Development for the rural population and agricultural modernization, environment, banking and finance, as well as industrial growth are primary. As each of these sectors develop, so too will telecommunications policy adapt. It is likely that the telecommunications sector will be given a priority of policy change developments in the future which could see major structural changes in 2010 or later.

Perhaps the largest stumbling block toward the development of telecommunications in Vietnam is the need for human resource development and the lack of telecommunications expertise in the bureaucracy. The training of telecommunications personnel at the engineering and managerial levels has been given a higher priority recently and is the focus of much cooperative efforts with the ITU and APT. Regional cooperation in standardization (especially needed in Vietnam's confusing mix of system equipment) is also a priority. In addition, and in no small measure, is the influence of ASEAN and the ATRC in helping Vietnam set an agenda for regulatory reform and bring it more in line with that of the more developed countries of ASEAN following the overall agreements for the ASEAN Free Trade Area.

In addition, Vietnam has looked to China, Germany and to some extent France in anticipating the changes evolving in countries with more than 40 year histories of monopoly PTT operations. It is therefore not unlikely to see that sector reforms in Germany and France, along with participation reforms similar to China, will be adapted to a certain degree in Vietnam.

As Vietnam makes further progress toward trade liberalisation, telecommunications may get an eventual fast-track for policy change if rural development needs are also equally provided. The eventual streamlining and making transparent approval processes in all trade will in the long-run eventually impact telecommunications. But the long colonial history and war periods have left Vietnam with the indelible impression of the need to meet the basic needs of its people in a self-sufficient and sustainable manner. Socialist ideals are still strong in terms of concepts of social equity and follow largely from strong traditional family values. While the economy moves toward more capitalist underpinnings, it is important to understand that the politics of the country, whether "communist" in name or not, will likely continue to promote social level welfare and equitable distributions for a long time to come. As such, the overall pace and direction of change, as well as specific change to telecommunications, will take a long view toward measured evolutionary progress as other processes are simultaneously "renovated" in Vietnam.

3.2 INDONESIA

Development in Indonesia follows a pattern of medium and long-term centralised development plans. The current five-year plan, Repelita VI (to 1999) covers the government's official development plan in nearly every sector of the economy and in the development of areas such as health and education. The Second Long-Term (25-year) Plan of Indonesia which runs through 2019, is concerned with strategic development issues and emphasizes major areas of development concern including resources (notably oil and natural gas), agriculture and food sustainability, and infrastructure development. With a rapidly increasing population expected to reach well over 200 million by the year 2000 and possibly 250 million at the end of the Second Long-Term Plan, concern in Indonesia for national unity, sustaining economic growth and providing for food, health and education needs are primary. In addition, Indonesia is also concerned over the long term with shifting its manufacturing base toward more high-skilled, technology-based industries, as well as developing the services sector.

Not surprisingly then, emphasis in Indonesia on development of rural areas and agriculture, the manufacturing sector, banking and finance as well as tourism parallel the emphasis of telecommunications development. This is being accomplished on several levels. First, the eventual interconnection of all inhabited islands of Indonesia via telecommunications is a goal tied directly with national unity. This has seen greater success with Indonesia's four Palapa satellites on orbit (one owned by PT Satelindo) for broadcast services across the archipelago rather than public point-to-point telecommunications. Secondly, priority of the development of telecommunications services has been focused on the manufacturing sector, banking and finance, and tourism. Expansion of networks for small business and residential service is at a lower priority.

Indonesia has gone from about 600,000 telephone main lines in 1983 to 2.7 million line units by 1995 and is expected to reach 8 million lines by the year 2000. Despite this increase, teledensity will only be about four telephone lines per 100 population at the turn of the century. Notwithstanding the need to continually build basic service infrastructure, the sheer cost of providing each additional percentage in teledensity in Indonesia is very high. As with many state-owned and controlled telecommunications systems around the world, Indonesia has found it necessary to make some structural adjustments to its telecommunications operations and regulation in order to accommodate a needed measure of private investment (domestic and foreign) to achieve its development goals.

Changes to official telecommunications policies in Indonesia often come after the fact that such structural changes are in defacto operation. Thus the policies of allowing for greater private participation [2] became law after such practices had become more commonplace. In addition, the structural changes to the two major telecommunications providers, PT Telekom and PT Indosat, are largely reflections of the manner in which telecommunications development could take place under the current and future Repelita Plans. With partial privatization of both organisations and the corporatisation of their operations, each is now well positioned to take advantage of expanding services and cooperating with international entities in the building of domestic and international services.

Basic telecommunications policy strategies in Indonesia include the continuation of a re-regulation process and opening of the market structure to more private (principally domestic) participation in order to provide for basic services into the scattered island provinces. One of the most visible results of this policy is the development of the Wartel (Warung Telephone). Wartel is a system of private operators in conjunction with PT Telekom, managing a small public telephone service within a community for public access as well as the addition of public payphones in many urban and rural areas. This has allowed for a bridge to cover the gap of Telekom's inability to provide full service into rural communities and in some parts of urban centres as well especially with such service coming at a lower development priority. Another example is the establishment of Pasific Satelit Nusantara (PSN) a private domestic Jakarta-based company that sells and leases transponder capacity. This company has set up a satellite-based public pay-phone VSAT network that should extend across the archipelago by 2000.

In addition, there are five major domestic cellular service providers in joint venture with PT Telekom including the international satellite service provider PT Satelindo which is part owned by Telecom and Indosat. These companies are also expecting to reach a combined penetration level of 20% by the year 2020.

Telecommunications policy in Indonesia is also concerned with facilitating an increased flow of private equity capital and management expertise into the sector along with management reform of PT Telekom and the private and public placement listings of Telekom and Indosat in particular. Telecommunications is in fact a leading sector in such reform under the development plans of Indonesia.

Still, major disparities remain between urban and rural areas in Indonesia. By 1996, roughly 80% of telephone subscribers were in the urban areas, yet some 75% of the population lives in rural areas. Policies to address this disparity and to increase telephone penetration into rural areas including area service licensing as well as build, operate and revenue sharing schemes are likely to continue in Indonesia.

The major policy hurdle of allowing for one or more direct basic service providers apart from Telekom is yet to be determined in Indonesia but a possibility after 2000 and into the next Repelita VII - X plans to 2019. By then, it is envisaged that Indonesia will reach 45 million telephone lines with a teledensity of some 18%. The sheer magnitude of the telecommunications development needs in terms of both human and financial resources may begin to force a more expansive policy approach. The next level of policy structural adjustment, allowing for competing and complementary private sector operators apart from PT Telekom for local calls may come as early as 2005 (moved forward from the original 2010 date of expiry of PT Telekom's monopoly license). PT Telekom's monopoly over domestic long-distance calls may be lifted even sooner, perhaps by 2001.

In addition to the overriding concern for basic services in Indonesia, plans are also underway to move forward with a new advanced telecommunications plan. Called Nusantara 21, the idea is to connect the entire archipelago to the much vaunted information superhighway. The project is to link the country's 27 provincial capitals with a broadband backbone network and is seen as the next major step forward beyond the Palapa satellite system developments of the past two decades. In order to accomplish this, some changes to telecommunications and broadcasting legislation have been anticipated. A new broadcast law was signed in September 1997 giving scope for private television stations to provide nation-wide coverage. But this new law does not make explicit the future levels of private participation that might be expected in broadcasting. [3] Such may be different, however, in telecommunications in the near furture. A review of the major telecommunication law (Law No. 3/1989) which provided originally for private participation in the telecommunications sector, is now under review. The idea is to "refurbish" this 8-year old law in anticipation of further private participation and possibly setting the scope for competition and further liberalisation of the sector in order to meet domestic development needs.

3.3 MALAYSIA

Perhaps in no other country of the ASEAN is the development of telecommunication systems and services tied directly to articulated national development plans to the extent as in Malaysia. While Singapore takes a strong strategic government policy, planning and implementation view of telecommunications to bolster national economic activity, Malaysia makes a more direct attempt to link telecommunications with the objectives of national development through the mechanism of central plans.

National development in the previous and next decade in Malaysia means primarily the drive for technological competitiveness and industrialization. Growth is fueled by the twin engines of export-led activities and infrastructure development projects including more recently, the development of "mega-projects" built around transportation, communications and energy. Much of this is articulated in the Vision 2020 plan which aims to make Malaysia a developed country by the year 2020. Vision 2020 has re-focused efforts to make Malaysia a market leader in telecommunications with for example the 421 metre Kuala Lumpur Tower, a leading infrastructure symbol.

However, there is also an overriding concern in Malaysia to develop equitable participation of all of its citizens in accelerating the growth of the economy. A major challenge for development planners, has been to place Malaysia at the leading edge of information and communications technologies, yet maintain some balance in socio-cultural development. Attempts to maintain this balance have been at times heavy-handed including past policies favouring 'bumiputra' (sons of the soil) interests which had the effect of developing equitable participation for what has been seen as the somewhat disadvantaged majority Malay population.

Through successive five-year development plans (the latest is the Seventh Malaysia Plan, 1996-2000) and the current ten-year development plan (Second Outline Perspective Plan OPP2, 1991-2000), Malaysia had tried to maintain a balance between industrialization and social development. Within each five year plan have been specific policies, strategies and programmes targeted for telecommunications development. These development plans have included the introduction of many new services as well as an aggressive expansion of networks. Such plans have given directly to the more liberalised licensing policies in order to meet development targets with such licenses favouring 'bumiputra' interests.

Malaysia was the first in ASEAN to promulgate a telecommunications development strategy that included the partial privatisation of the state-owned and controlled monopoly operator in 1987 and later to develop a more liberalised sector which included primarily, the introduction of competition by locally-owned (and in some cases, government-linked) companies in both basic and non-basic wireline and wireless services.

On this score, Malaysia has led ASEAN in the licensing of major system operators to provide telecommunications services in the country. There are now four basic network licensees (two nationwide), three international network (gateway) providers, eight cellular services providers and 16 pager services operators, each licensed for a localised service area. There are also multiple operators for trunked radio service, value-added services, radio leased channel services and two nationwide pay phone operators. The government has promised even more licenses as development needs warrant.

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With so many licenses awarded so quickly, however, the government began to wonder aloud in mid-1995 if it had in fact gone too far in liberalising the sector and publicly encouraged some operators to merge in a effort to stave off some negative effects of over-competition that was seen to be developing. The market held firm however and no such mergers took place amongst the major operators.

In the Sixth (1991-1995) and Seventh (1996-2000) Malaysia Plans, information technology broadly defined as the convergence of micro-electronics, computers and telecommunications as well as the utilisation of software technology have been given prominence. Some RM 6 billion (US$2.4 billion) was allocated in the sixth plan as total expenditure for telecommunications development, and the current seventh plan includes another RM6b.

In an effort to expand telecommunications development beyond terrestrial systems and similar to Indonesia and Thailand before it, Malaysia has also launched its own domestic geostationary communication satellite, Measat. This was coupled with a relaxation on the ban on satellite dish operations as well. Owned by Binariang Sdn. Bhd. which has a nationwide basic services operating license, Measat provides broadcast television services and data communications services in addition to telephony services in Malaysia and regionally.

In addition to the national development plans of Malaysia, the National Telecommunications Policy (NTP, 1994) encourages the utilisation of information technology networks for many new services. The plan spells out objectives, strategies, guidelines for local operators, investors and government in areas such as technology transfer, research and development and human resource development. In 1996, the government articulated a further major development initiative following its conception in the 1994 NTP plan. This new policy-driven initiative, known as the Multi-Media Super Corridor (MSC) project is at once ambitious as it is vague. It is estimated that some RM40b (US$15b) will be needed for telecommunications infrastructure in the MSC which has total projected costs of anywhere between $20 and 40billion. Despite recent setbacks in the currency and stockmarkets of Malaysia, the economy continues in a very robust manner and is likely to grow by some 7-8% again for each of the next three to five years. The market currency devaluation has forced Malaysia to hold off on some mega-infrastructure projects for a short while, however plans for the Mulit-media Super Corridor will not be affected overall.

The MSC gives a physical and virtual presence to high technology development in the domains of information technology and telecommunications. The physical portion of the project is largely the development of a 15-by-50km track of land south of Kuala Lumpur (to include the new administrative capital city and situated just north of the new airport) to locate various high-tech parks, research and development centres as well as 'tele-suburbs' and a 'cyber-village'. A high-capacity fibre-optic cable system will form the backbone of communications with new policies and 'cyber-laws" to make IT development projects attractive. The goal is to attract cutting edge corporations involved in areas ranging from custom-chip manufacturing to multi-media publishing. As of mid-1997 some 30 companies had signed on to the MSC project in some form or another including Sun Microsystems, Siemans and Microsoft. Applications for gaining MSC status stood at about 500 in mid-1997 with about a 50-50 ratio of local and foreign companies expressing interest.

Despite much hyped-interest in the MSC project, major basic development in telecommunications is still needed in Malaysia. Telephone mainline density stood at 11.6 per 100 population in 1993 and had risen to 15 at the end of the Sixth Malaysia plan in 1995. Under the Seventh Malaysia Plan, telephone mainline density is targeted to rise to 29 per 100 population by 2000 and then upwards of 45-50/100 by 2020. However, such figures mask somewhat the urban-rural split. Currently, telephone density in rural areas is only about 4 per 100 population and is targeted to rise to 8.8 by the year 2000. Part of the lack of telephone access in rural areas is being addressed with the aggressive placement of rural public pay phones. The target is to have nearly 70,000 pay phones in rural areas by the year 2000, up from the installed base of 22,500 at the end of 1995.

So where does all the money come from to develop telecommunications in Malaysia? Certainly government allocation continues at a high rate given Malaysia's impressive economic gains over the past decade. This is likely to continue despite recent setbacks in currency speculation in mid-1997 as the major fundamentals of the Malaysian economy remain strong. Also, the proceeds of the various successive tranches of partial privatisation of Malaysia Telekom have contributed back to telecommunications development. Certainly Malaysia is looking to private local licensees to provide the investment impetus for many new services. However, the need for the primarily government-owned Telekom Malaysia to raise additional funds to meet its ambitious local network development targets and international expansion plans has also meant a need to look at more sophisticated funding mechanisms. As such, Telekom Malaysia announced plans in April '97 to raise some US$350 million in bonds. However, these plans were put on hold as of late October '97 due primarily to the devaluation of the ringgit. Nonetheless, as the Malaysian economy rebounds from its 1997 downturn, multi-billion dollar investments in network and services expansion from a combination of future bond funds coupled with government direct allocation, joint ventures, supplier credits and foreign equity investment will continue.

For the near future, telecommunications policy is likely to continue to be guided by the twin principles of infrastructure and socially equitable development. A further liberalisation of the telecommunications market to include direct foreign operators is therefore not in the offing at least through the next decade. However, a greater emphasis on joint ventures with foreign participation especially in the areas of human resource development and technology transfer are likely to be highlighted. In addition, as Malaysia Telekom and other local operators seek to expand regionally, partnerships and alliances will play a greater role and provide for new market opportunities.

3.4 ASEAN COUNTRY-BY-COUNTRY POLICY TRENDS

From the examples of Vietnam, Indonesia and Malaysia, it is clear that the change in policy in telecommunications that continues in each of these countries is driven more from the realities of internal development needs and political priorities than from any set of external pressures. The following sections outline the range of development priorities of each of the remaining six countries of ASEAN and places their trends in telecommunications in the context of their own development goals.

Brunei

Re-establishing telecommunications development priorities in Brunei Darulsalam is evident in the 7th five-year development plan (RKN-7) from 1996-2001. Brunei's recent push to somewhat diversify the oil economy (mainly by expanding tourism) has, as a priority in the telecommunications sector, the development of broadband infrastructure and services. In addition, Brunei may begin moving toward a more customer-oriented service model for its telecommunications operations which has a less than fully developed mainline teledensity of some 30 per 100 population despite the riches of oil revenues to this tiny (300,000 pop.) state. Plans are for teledensity to reach 40 per 100 by the year 2000.

In September 1996, a cellular service which was previously for the exclusive use of the royal family was made publicly available and has some 7,500 users to date.

The next five years will see almost no change to telecommunication policy in Brunei with exclusive operations accruing to Jabatan Telekom Brunei for domestic wireline and international service and to DST Communications, a local private company for cellular service. A corporatisation and partial privatisation of JTB may be possible for largely financial reasons, however, this government department will continue to be the operator and regulator for some time. Some competition in non-basic services may be forthcoming over the next five years but the size of the market may not make such competition viable. Instead efforts may be directed at making JBT more efficient and to improve the quality of services provided.

Laos

Seventy-five percent of the 4.7 million people of the Lao, PDR live in rural areas with no telecommunication services. The economy is mainly subsistence and its land-locked and remote geography contribute to make Laos the least developed of the ASEAN countries (admitted along with Myanmar in 1997). Major development projects now revolve around the provision of electricity through a series of 20 controversial dam projects along the Mekong river. But with influential neighbor Thailand's recent economic woes, such plans may be slowed down for now. Other than these major hydro-electric projects, scant development is occurring in other major sectors including telecommunications. A major hurdle will need to be crossed in transforming from a centrally planned economy to one that is more in line with the rest of ASEAN. This will be very difficult despite the official endorsement of *jintanakan mai* or "new thinking", the Laotian euphamism for economic reform similar to Vietnam's *doi moi*. Today, most Laotians still do not have electricity, running water or paved roads in their villages.

ETL (Enterprises de Telecommunications Lao) is the state-owned operator (government department) that was established in 1995 after a split of telecommunications and postal services. Following successive New Zealand and German consultant projects, ETL is now beginning a process endorsed by the World Bank to raise capital through the international marketplace as the government does not expect to commit funds to ETL. The establishment of a legal framework to make this possible continues in Laos although a general regulatory morass still exists. Major projects to begin to expand network services outside the capital Vientiane have begun and the next development plan period for Laos from 1998 will include a number of supplier and foreign operator credit projects. With only about 1 telephone mainline per 100 population in Laos in 1997 and nearly all of those in Vientiane, plans are to increase to 3 lines per 100 by 2000 with a focus on helping achieve modest development objectives of improving conditions in the provincial and district capitals. Rural telephony service access appears however to still be many years away.

Myanmar

The dictatorial military government of Myanmar was admitted to ASEAN under the policy of constructive engagement in 1997. Myanmar's small, dilapidated telecoms systems are near the bottom of teledensity in the world. There are only about 150,000 telephone mainlines in Myanmar of which some 67,000 are in the capital Yangoon. Some exchanges are still using 35-year-old cross-bar switches. There are some 400 manual switches still in use. Scant government interest and expertise over the past several years has pushed telecoms development off the priority page. All telecommunications operations are the exclusive domain of Myanmar Post and Telecommunications (MPT) under the Ministry of Communications, Posts and Telegraph. Since 1993 the government has installed a small PC computer network for administrative purposes to replace telegraph instruments and anticipates the development of a packet-switched data network between Yangoon and Mandalay. Several foreign suppliers including Ericsson Australia as well as Nortel and Nokia supplying through Loxley of Thailand are starting to provide cellular (amps) service in Myanmar.

Nonetheless, development of basic services are likely to continue to be neglected over the next few years.

Can ASEAN make a difference to overcome the lack of internal development policy advancement and nudge Myanmar toward a more responsive development plan for telecommunications?

The Deputy Prime Minister of Malaysia, Anwar Ibrahim, has suggested a policy of "constructive involvement" as an ASEAN cornerstone. Could this be a precursor to more active ASEAN involvement in Myanmar to pressure for political change? It remains to be seen if such efforts can trickle-down to telecoms policy in particular.

Philippines

Telecommunications operations in the Philippines have long been in private hands with the Philippines Long Distance Telephone (PLDT) by far the dominant player. In recent years, the structure of telecommunications operations has been better rationalized through a series of presidential executive orders and a number of circulars of the Department of Transportation and Communication (DOTC) and the National Telecommunications Commission (NTC) which respectively act as the policy-making body and regulatory arm, the latter which also provides some limited services in under-served rural areas.

The telecommunications development plan of 1993 saw an aggressive re-orientation of the telecommunications market in the Philippines in terms of moves to provide interconnection of all operators with PLDT and with an aggressive satellite programme which saw the launch of the Agila (Eagle) geostationary domestic satellite for telecoms and broadcast services in August 1997.

The main arena of economic and political development in the Philippines might be characterized as a "psyche of struggle" which has permeated structural evolution in many domains. This almost feisty character of national development focus sees aggressive stances taken in many domains including recently PLDT's success at getting the United States FCC to order two callback services to stop operation to the Philippines. [4] But plans for the development of basic services from 1996 to 2000 are seeing this political 'struggle' process being replaced by more rationale economic market-oriented policy developments.

The establishment of the Republic Act 7925 in March 1995, the "Philippines Telecommunication Policy Act", provided for this process change. The Act established a framework for a liberalized sector and to promote an open and competitive telecommunications environment. This also set the stage for the Philippines to offer a liberalized position vis-a-vis the WTO agreements.

Through the exercise of dividing the nation into service areas and the allowance of up to 40% foreign ownership in domestic carriers, the Philippines is now well on its way to making significant progress in increasing mainline teledensity and removing service demand backlogs as a priority. This is being done through the establishment of extensive backbone systems, the establishment of a second inter-exchange carrier in addition to PLDT, and the plans of each basic service provider to contribute to building mainlines. The goal is to reach 7.3 million lines for a teledensity of 10 per 100 population by the end of 1998. Beyond that, goals have been set to reach some 25 mainlines per 100 by 2015 as outlined by the updated National Telecommunications Development Plan (NTDP) or Telecom Master Plan for 1996-2015. Other projections are not so optimistic. Some private analysts see mainline growth only reaching 5.5 million lines by the year 2000 or a teledensity of 7.5 per 100 population.

In addition, the DOTC has embarked on a program to develop the Philippines national information infrastructure (PII) with a major policy review of issues such as universal access, timing, finance, competition and content.

For the near future, continued moves by DOTC and NTC will be to further deregulate the market (meaning allowing for further competition in selected services) and to continue to privatize some government-installed facilities. There will also be a continued focus on seeing fair and equitable interconnection access for the nine major local carriers as the Philippines struggles to make serious progress in a major mainline build-out.

Singapore

The introduction of competition in Singapore's drive toward a high degree of advanced networking in its deliberately controlled environment is seen as key to continuing its own self-styled success. The continuation of basic fixed and mobile systems infrastructure along with accelerated development of advanced systems and services top the development priorities in telecommunications as the island state strives to build a strategic and sustainable position in world trade.

The introduction of a second mobile phone operator, and three new pager operators came in April 1997. For the first time, the Telecommunications Authority of Singapore (TAS), the regulator, finds itself in a major regulatory role in mediating between disputes of competing operators. While decision-making has usually been swift, owing more to the pride of efficiency in Singapore, the transparency of that decision making process is still somewhat lacking.

Singapore has recently embarked on a major structural market re-orientation which is seeing significant competition introduced for the first time. A current tender is in progress for up to two licenses for basic services and up to two licenses for cellular mobile telephone services to begin commercial operation in 2000. This will effectively end SingTel's monopoly on basic services seven years earlier than their original license expiry date. In addition, TAS announced, through the current tender document for the public basic telecoms services license, that there will be more licenses for basic service operators in 2002, without giving a number. Such a strategy will allow for maximum infrastructure expansion (although duplication is a concern) and for a competitive environment. However, the overall combined competitive effort of the new licensees will be carefully designed so as not to over-erode the position of SingTel.

The new licenses for basic and wireless services will of course go to local operators who have been quick to establish consortia of partnerships with foreign operators. Foreign equity participation of up to 49% is allowed for the provision of basic telecoms service. Also, the resale of leased circuit services has been allowed since Feb. '97 for intra-corporate communication defined as internal communication between holding and subsidiary companies. The government's move to allow for significant competition in telecommunications services in Singapore is seen as a response to act reciprocally as it expands internationally. It is also aimed at continuing the push to build up local infrastructure to meet future business opportunities and allow for market competition to provide for improved services and assumed lower costs.

The development of Singapore ONE (One Network for Everyone) is the latest infrastructure development plan to build major broadband open network facilities in Singapore to meet the needs of information delivery services, business applications and multi-media developments. This government-led project is a consortia of numerous organisations to install a broadband network to homes and businesses throughout the island with overlays on the existing telecommunications and cable television networks. The project is expected to be implemented in two phases with major network backbone facilities and pilot projects developed to 1999 and a second phase of development from 1999 onwards with a focus on commercial interactive multimedia services to be made available.

Thailand

Continuing development indecisiveness in Thailand resulting in a defacto policy of tolerating increasing free-market local players with government and military connections in an inadequately regulated environment characterises Thailand today. In addition, the economic downturn and currency devaluation of 1997 has meant that several telecommunications companies in Thailand are putting the brakes on new investment while others are reeling in additional debt caused by being caught heavy in foreign loans with short-term payback. This situation means that many of Thailand's more ambitious telecommunication development goals will be pushed back for several more years. This is exacerbated by the delay in drafting the Telecoms Master Plan that was to be presented in 1997. That delay will mean that further market liberalisation moves, especially in terms of additional market competition in basic services with the Telephone Organisation of Thailand (TOT) may be put off yet again. Thai authorities say that it remains committed to its WTO agreement to open up the market by 2006.

On the insistence of the IMF as part of the financial rescue package offered in the second half of 1997, the Transport and Communications Ministry submitted, in mid-September 1997, plans for the privatisation of TOT. These plans include first the incorporation of a limited company with TOT as the major shareholder and then the offer of a 25% stake to a strategic international partner. Next, 22% of the equity will be offered in private placements before an additional 23% is sold in shares to the public. It remains to be seen when these plans are to be implemented. By law such changes must be approved by the Thai parliament which has in the past not been in a position to give such approval. There is some reason to believe that perhaps a royal decree can circumvent the parliamentary process this time to move the TOT privatisation forward.

Therefore it can be concluded that the prospects for the development of a good basic telecommunications infrastructure in Thailand is to be delayed yet again. Further, the growth and competition in cellular services has made the cost of calls less expensive than through wireline services, making further expansion less attractive. One of Thailand's three basic service providers, Telecoms Asia Corp. Plc., has installed 2.6 million lines in the Bangkok area, but only about half have been subscribed.

Possible parliamentary changes to pave the way for a new telecoms industry structure are unlikely to proceed until Thailand's economic juggernaut gets back on track in perhaps two to three years. Even so, it will only be within yet another ten years under any new legislation and a master plan that liberalisation will begin in earnest. Meantime, local service area licensed private telecommunications firms (Thailand's definition of deregulation) and firms under contract with CAT and TOT to provide infrastructure development are likely to see a temporary slowdown. As of Oct 1997, there were 6.1 million basic telephone lines in Thailand for a ratio of about 10 lines per 100 population. The government has stated that it intends to expand by another 6 million lines after 1999 in order to achieve the target of 18.5 telephones per 100 population (with nearly half of all telephones in Bangkok alone) at the end of the Eighth National Plan (1996-2001).

IV. ASEAN, APEC AND THE WTO

While internal development priorities are primary to understanding policy positions and possible future changes, some external influences, including participation in the Asia Pacific Economic Cooperation (APEC) and the World Trade Organisation (WTO), are worth special mention. As telecommunication development becomes a higher priority in many countries of the ASEAN, investment capital from outside state coffers will be sought because of the huge capital investment needs which cannot be meet solely from state sources. However, in order to attract needed outside investment, be it from domestic or international sources, many conditions need to be in place. This is where the agreements of such organisations as the WTO can become important in the ASEAN region. In fact, it is the WTO agreements which have, in part, given ASEAN itself impetus to formulate regional policy in a likewise manner through the recent promotion of the idea of a free investment area.

Similarly, the APEC forum, with its Telecommunications Working Group (APEC TEL), seeks to educate officials of member economies and explore mutually reinforcing areas of cooperation. Lately, the focus of the Working Group as directed by the APEC Ministers has been on identifying the needs of the information sector as well as users of information infrastructure. Telecommunications in this regard is seen as a "model" sector in achieving the goals of the "Bogor objectives." As the APEC process matures, it may eventually adopt a similar process of agreement formation as the WTO.

The Information Technology Agreement of the WTO which came into effect in July 1997 and the Telecoms framework agreement which came into effect in January 1998 are indeed substantive. The fact that meetings to negotiate approval for these agreements were held in Singapore in December 1996 (and concluded in Geneva) is also not without substantive importance and symbolism for the ASEAN region. In effect, the agreement will help guarantee stability in government policy which makes telecommunications investment attractive. But as far as the larger ASEAN is concerned, will the agreements form a means for fostering further development? The question should be who benefits with the adoption of such agreements and to what degree and at what pace will such agreements be implemented in each country according their own development goals.

Not all ASEAN members are WTO members. While this should not necessarily be a stumbling block toward policy reform, it is clear that accession to the Reference Paper on Regulatory Principles for example, would help to ensure stability for investment of additional and competing systems and services through existing network interconnection. But even WTO member countries will implement such accords in differing ways while still adhering to the principles of the agreement. This can be seen in the current tender process for up to two basic service licenses in Singapore to begin commercial services April 1, 2000. Already, the Government of Singapore has indicated that favour will be given to bidding consortia which can provide substantial new infrastructure. While still providing for fair interconnect with the incumbent as prescribed by the WTO, the new operators will be licensed for facilities-based competition and are expected to build infrastructure that employs the latest technology. The market opening is not for entrants that would simply free-ride on SingTel's infrastructure.

Nonetheless, the WTO process itself, which helps foster policy change among agreeing countries, can also be seen as a lever to hasten, in some cases, that change process. But not all ASEAN countries are prepared to move at the same pace. There is, as yet, no ASEAN consensus toward the WTO. Not all ASEAN members that are also a part of the WTO would agree en-bloc to the same implementation timetable let alone the interpretation and scope of change required. In addition, at least one ASEAN country, Myanmar does not even have normal trade relations with some of its fellow ASEAN members let alone others outside ASEAN.

The pressure brought to bear on each country that desires to accede to the WTO agreements means they must formulate internal policy in a general alignment with other countries. Nonetheless each ASEAN country will take a different view toward the degree of accession. This makes the prospects for a unified ASEAN position vis-a-vis the WTO unsure in the near future. Such a unified position remains in the realm of possibility, however, if ASEAN begins to move toward the formation of a trade union with for example major substantive progress on the formation of the ASEAN Free Trade Area. If efforts such as those sought by the ATRC in providing a common telecommunications regulatory position vis-a-vis the ITU begin to spill over into more general economic matters, then a more convergent ASEAN position toward the WTO may be forthcoming. More than likely, ASEAN will for the near future, emphasize only those areas of existing commonalty vis-a-vis the WTO such as the newly proposed free investment area which focuses on the specifics of investment regulation reform rather than overall trade policy. With the addition of the two newest members, Laos and Myanmar, finding a consensus within ASEAN on smaller, more manageable issues seems more likely.

V. CONCLUSIONS

From the priority of beginning to get the regulatory house in order in some developing nations of Southeast Asia, to coping with stepping into the league of the technologically developed for others, understanding the transformation of telecommunication policy due to each country's own development needs and priorities is key for both incumbent and new interests in the region as a whole. At the same time, the possible formation of a consensus of direction for the scope of economic development and political priorities of ASEAN as a whole might begin to move each member country toward a more common base in the evolution of telecommunications regulations. Certainly accession to WTO agreements, despite differences in specific implementations, is important in this endeavor. So too, however, will be ASEAN's ability to cope with the diversity of its own members in setting common priorities and goals in terms of agreeable cooperative efforts at telecommunications reform and development. Nonetheless, internal development priorities and socio-political environments of each ASEAN country will continue to be the major determinant in telecommunications development in each specific country for many years to come.

The telecommunication environment in many of the ASEAN countries is such that those allowed to profit through investment and benefit through service development are still few. Efforts to move from a stagnant situation will become a major challenge for ASEAN as a whole as to whether its more enlightened governments can indeed constructively engage its fellow members to garner the political will to enlarge the telecommunications pie, to include more players and be required simultaneously to spread the incumbent largesse. That ASEAN countries should look to their more successful members for guidance is a challenge yet to be met. It is also an opportunity not to be missed.

NOTES

[1] Growth Triangles refer to the cooperative arrangements between three bordering countries in Southeast Asia to engender economic growth by taking advantage of each countries different strengths to combine into one development plan. Growth triangles and telecommunication development in Southeast Asia is discussed by the author in a chapter in the forthcoming

book Communication and Trade (Lamberton, Ed.), Hampton Press.

[2] Private participation in telecommunications projects in Indonesia is largely through domestic joint ventures. Foreign capital investment is through the PMA (Penanaman Modal Asing) arrangements of joint ventures with Indonesian national companies and the KSO (similar to build, transfer operate) arrangements for joint operation.

[3] Indonesian companies providing broadcasting distribution services may also provide telecommunications services with a license from the Ministry of Tourism, Posts and Telecommunications and approval from the Ministry of Information.

[4] Several carriers in the Philippines, including PLDT, have also filed a motion for the FCC to reconsider its unilateral decision on the reduction of settlement fees and have not been keen to sign new agreements.

REFERENCES

APT Telecommunications Yearbook, Bangkok: Asia Pacific Telecommunity, 1997.

Barlow, Roger, "Telecommunications in Vietnam," Tel-Asia 1995, p.41-43.

Gilbert, A. Lee, "Wireless Infrastructure in Vietnam: evaluating an emergent leapfrog strategy," PTC 97 Proceedings, Honolulu: Pacific Telecommunications Council, p. 62-70.

Hashim, Ramah, Mapping Telecommunication Needs and Priorities from a National Development Perspective: Malaysia". Unpublished paper, Singapore: AMIC, Feb. 1995.

Hudson, Heather E., "Restructuring of the Telecommunications Sector in Southeast Asia: Policies and Pitfalls," PTC 97 Proceedings, Honolulu: Pacific Telecommunications Council, p. 87-98.

Idris, Naswil, "Mapping Telecommunication Needs and Priorities in Indonesia from a National Development Perspective." Unpublished paper. Singapore: AMIC, Oct. 1994.

"Mapping Telecommunications Need and Priorities in Vietnam from a National Development Perspective." Unpublished paper prepared by the Directorate-General for Posts and Telecommunications, Hanoi. Singapore: AMIC, 1994.

Murray, Geoffrey, Vietnam: Dawn of a New Market. Richmond, Surrey, UK: China Library (Curzon Press Ltd.), 1997.

Ono, Ryota, "Obstacles to and Strategies for Telecommunication Development", Pacific Telecommunications Review, Honolulu: Pacific Telecommunications Council, March 1997, p.20-34.

Petrazzini, Ben A, and Tung X Bui, Cautious Reforming (Vietnam Report), Asian Communications, Vol. 9, No. 5, May 1995, p. 41-45.

Sinha, Nikhil, "Telecommunications, Capabilities and Development: Towards an Integrated Framework for Development Communications," Media Asia, Vol. 22, No. 1, 1995, p.17-25.

Telecommunications Regulatory Environment in APEC Member Economies. Singapore: APEC Secretariat, 1996.

"WTO and the Asia-Pacific Region" [issue subject; includes 8 articles] APT Telecom Journal, Vol.9, No. 3, July 1997.

Vu Tuan Anh, Development in Vietnam: Policy Reform and Economic Growth. Singapore: Institute of Southeast Asian Studies, 1994.

Policy and economic considerations in the auctioning of spectrum

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Abstract

With the large amount of money collected during the auctioning of spectrum licenses in the US, administrations around the world have become increasingly interested in properly managing the wireless licensing process. It is important to strike a balance amongst a number of interrelated and complex factors, including how much spectrum should be licensed, for what applications, and who should be eligible to hold licenses.

Spectrum

The electromagnetic spectrum is like a large tract of land. It can be divided up and managed. As technologies evolve and new capabilities become available, different parts of the spectrum can be "farmed" out. "Owning" spectrum is similar to owning land.

Lower frequencies were the first to be exploited commercially as technologies were more readily available. With the development of high speed processors and semiconductor devices, higher frequency parts of the spectrum have become available. While it is true that no new spectrum can be created, portions can become usable as new technologies are developed.

The electromagnetic spectrum of interest (and that one typically thinks of as being related to "radio" communications) consists of frequencies that are higher than audible but lower than visible. This covers a huge range from around 30,000 Hz (cycles per second) to over 300 billion Hz.

Bands of spectrum are organized by licensing bodies in individual countries and are also coordinated on an international level (this is particularly important for satellite services, airline communications, etc.). The World Radio Conference (WRC), under the auspices of the United Nations, is used as the forum for governments to coordinate the use of frequencies. Countries with close geographic proximity also have extensive coordination requirements along their borders, and their respective uses of spectrum bands tend to be quite similar.

The following table shows the types of services typically found by groupings of spectrum (in the North American context), as well as the "newer" uses that are present in the market or are developing.

Table 1 - Overview of spectrum applications

Bands	**Existing services**	**Newer service uses**
Below 30 MHz	AM radio broadcast Maritime mobile Telegraph Shortwave broadcast Time signals	
VHF (30 to 300 MHz)	TV broadcasting (channels 2-13) FM radio broadcast Paging Air traffic control Public safety, PMR Dispatch (SMR)	Digital TV allotment (US) Interactive voice/data (200 MHz - US)
UHF (300 MHz to 1 GHz)	TV broadcasting (channels 14-69) Public safety, PMR Cellular telephony Air to ground service	Enhanced SMR (900 MHz) 900 MHz Paging and NPCS Digital TV allotment (US) Rural wireless local loop (pending)
UHF (1 to 3 GHz)	Mobile satellite (MSAT) Wireless cable (MMDS) Low capacity fixed links	PCS (1.9 GHz) WCS (2.3 GHz - US) LEO satellites (1.6 GHz, others) Digital MDS, MCS (2.5 GHz) (wireless cable, Internet) Digital audio broadcast (satellite)
SHF (3 to 30 GHz)	Satellite services (C, Ku bands) Common carrier (telcos)	Direct broadcast satellite (DBS) New mobile services (4.6 GHz) Ka band satellite (19/23/29 GHz) Wireless local loop (3.4 GHz - UK) Unlicensed internet access (5 GHz) (US) MCS and LMCS (wireless cable, Internet) Wireless CAP (23 GHz)
EHF (30 to 300 GHz)	Radionavigation Radio astronomy Intersatellite communications	Wireless CAP (38 GHz and proposed 41 GHz) New 43 GHz (US)

Note: scattered in many bands are industrial, scientific, and medical (ISM) applications, unlicensed consumer electronic devices, military radio and radar systems.

Value of spectrum

Spectrum is a publicly-owned resource, and hence the public should be entitled to compensation from entities that exploit the resource for commercial benefit. The many different uses of spectrum, as outlined in Table 1, indicate that there are many different values that can be attached to it.

Thus the compensation that the public may expect from different spectrum applications will vary. Since governments can also impact what type of services are offered and by whom, spectrum management becomes a complex interaction of consumer/public, commercial and policy interests.

The difference in the market perceptions of spectrum values is clear in the US, where the FCC completed fourteen auctions over a 4 year period. These auctions resulted in the assignment of over 4,300 licenses for spectrum-based services, and raised a total of $23.1 billion for the US Treasury.[i]

The results of several US auctions are summarized in Table 2, below.

Table 2 - Summary of US auction results

	Auction results[ii]
	US$ per pop. per band[iii]
PCS - A/B band[iv]	$3.5 to $5
PCS - C band	$17 to $19
PCS - D/E/F band	$3 to $4
MDS[v]	86¢
WCS[vi]	5¢

There are two notable issues in these results, the difference between PCS and "other" applications, and the difference between the various PCS bands. There are likely many reasons for these differences, some of which are discussed below:

Differences between PCS and the other applications. Bidders clearly saw PCS as offering a higher commercial value than the MDS or WCS applications. PCS is similar to cellular service in that it offers mobility and roaming. Based on the success of the cellular business, bidders likely assumed that PCS would have similarly high values relative to other non-cellular-like businesses. PCS also is thus playing into a market which essentially exists and which has been growing rapidly. MDS and WCS were perhaps perceived as being useful for addressing smaller niche markets, which would thus be of lower economic value.

- Differences amongst the PCS bands. PCS bands A, B and C are technically identical, in that they provide the licensee with 30 MHz of spectrum. There is no intuitive reason as to why the values would be perceived as being significantly different. At the time of licensing, the A and B bidders knew that the C band would be licensed, and similarly when the C band was licensed, the A and B values were readily known. The higher C band result is likely due to differences in financing terms offered by the FCC (lower upfront payments, and installment terms) which may have been factored into the bidding.[vii]

As part of work completed for Industry Canada, LEMAY-YATES ASSOCIATES INC. developed six operating models to estimate the market value of the different licenses (all considering national coverage), considering the different entities that make up the Canadian market:

1. Cellular service alone
2. PCS service alone
3. ESMR service alone
4. Cellular and PCS services combined
5. PCS and ESMR services combined
6. Cellular, PCS and ESMR services combined

To the extent possible, the models grouped licensees in a particular segment so as to provide an estimate of the license value to the industry as a whole. The resultant value of each model is expressed as "net present value per head of population" or NPV/pop. This normalizes the models for comparison on a common basis.

Overall cellular/PCS penetration was estimated to grow to some 40% of the population by 2004. For each of the cellular and PCS models, two forecasts of subscriber penetration were used to reflect differing views as to market evolution. In the "base case" forecast, cellular was assumed to capture the lion's share of the market; in the "alternate case" forecast PCS was assumed to do so.

The estimated market valuations are shown in the following table (in Canadian $):

Net present value of market models (NPV/pop.)[viii]

	Model	Base case forecast		Alternative forecast (PCS > Cellular)	
1	Cellular service	$	*245.44*	$	*148.36*
2	PCS service	$	*12.19*	$	*29.32*
3	ESMR service	$	*11.49*	$	*11.49*
4	Cellular and PCS	$	*280.23*	$	*267.52*
5	PCS and ESMR	$	*22.23*	$	*49.08*
6	Cellular, PCS & ESMR	$	*305.59*	$	*292.88*

The results for cellular service alone and in combination with other services are very high relative to the other cases. It should be kept in mind that the cellular model is artificial in the sense that the major investments, and the associated risks, have been treated as sunk costs (other than the net asset base assumed to be acquired at the outset). Hence the going forward incremental investment is minimal.

Approaches to licensing

The "traditional" method of selecting licensees has relied on governments making a comparative selection from amongst a number of applicants. The winning licensee would then pay an annual fee intended to recover the government's cost of spectrum management.

There are three basic types of competitive allocation processes currently in use by various administrations, in particular:[ix]

- In a comparative process, proposals are judged on their merits with spectrum being allotted to applicants who best meet predetermined criteria. One can tailor the criteria to emphasize those concerns of relevance to the issuing authority, e.g. previous record in providing similar services, financial backing, research and development investment.[x]

- In a lottery, the Government identifies available spectrum and prescribes, as required, minimum qualification criteria and conditions of authorization. Applicants participate in a random draw for the available spectrum, in the expectation that equity is achieved if each applicant has an equal chance of winning.

- In an auction, the Government identifies the available spectrum and invites applicants to submit bids, with the underlying assumption being that awarding the spectrum to whoever values it the most will result in economically efficient outcomes and resource rent capture by the public.

Auctioning

Many countries are reviewing and/or implementing auctions. A few examples are discussed below:

- US - The US, as discussed above, has made extensive use of auctions replacing a system of lotteries. Lotteries created windfall gains to the lottery winners. With auctions, the excess now goes to the government instead.

- Canada - Introduced an amendment to the Radiocommunications Act in 1996 providing for auctioning as an alternative to the traditional administrative pricing/comparative selection regime. Canada plans to auction LMCS bands in 1998, and plans others in the future.[xi]

- Australia - Has begun auctions, having completed a first auction for 500 MHz range spectrum. PCS and LMDS auctions are also in development.

- New Zealand - In June 1990, New Zealand auctioned three cellular licenses simultaneously using a sealed bid. It used a second price sealed-tender auction, which meant that the highest bidder won the license, but only paid the amount bid by the second highest bidder.[xii]

- United Kingdom - Continues with a mixed environment for award of licenses. Some licenses with administrative fees may be adjusted based on "best alternative use" pricing[xiii]; licenses may also be auctioned.

- Germany - Licenses for ERMES paging services were auctioned in September 1996 using a simultaneous multiple-round system based on the US model. There were three national licenses awarded as well as a 15 regional channels.[xiv]

- India - In August 1995, India held an auction for two GSM licenses in each of 20 regions. The rules allowed consortia to bid in any and all of the regions. The highest bidder won the first license in each region and had to pay the amount it bid in an up-front payment and subsequent annual payments. The second highest bidder had to match the highest bidder if it wanted to receive the second license. If it declined, the right to the second license fell to the third highest bidder, which had to match the highest bidder in order to receive the license. If no bidder matched the highest bid, then the second license would be re-auctioned.[xv]

Hybrid licensing

In some cases a hybrid approach can be used. Hybrids can consist of a combination of a comparative evaluation with either an auction, a lottery or some other form of bidding process. A hybrid approach can also be expressed as a single number representative of both license fee and some other criteria (see Brazil example below). A hybrid approach is useful to motivate bidders to deploy their operations to meet specific government objectives such as population coverage, low tariffs for mass market appeal, etc. Some examples of the approaches used are discussed below:

- Poland - In early 1996, Poland licensed two GSM providers to compete with the incumbent analog cellular operator. The process used was a competitive bid wherein the Polish government established a minimum initial fee, as well as ongoing fees per subscriber per year. Bidders had to commit to pay the yearly fees per subscriber for every subscriber part of their business plan irrespective of if these numbers were achieved or not. In addition, the price per subscriber increased with time. This approach motivated bidders for a rapid and massive launch as well as for increasing number of subscribers as rapidly as possible. As recent history shows, GSM is a resounding success in Poland with more than 300,000 subscribers in approximately 6 months.

- Brazil - In early 1997 Brazil accepted one-time bids for B-band cellular licenses for each of 10 regions in the country. The bidders were provided with a formula to calculate a number of bid points. The bid point formula was the result of a combination of an upfront price as well as proposed tariffs. The formula calculated a price index based on a pre-determined minimum license fee for each license in its first part. A second index was calculated using the difference between maximum tariffs which could be submitted by the bidders and the actual amount. A specific basket of services, presumably representative of usage, was developed for each license being awarded. The final bid number of each bidder for each license area was the sum of the two indexes. With this method, the Brazilian government could hope to obtain the maximum amount of money possible while ensuring that the tariffs offered would be no higher than those of the current analog A-band operators.

Socio-economic and policy considerations

Spectrum licenses have inherent value to their holders, and radio license fees should thus reflect these values in order to compensate the public for the use of spectrum resources. There are also many socio-economic and policy considerations which go into developing an effective spectrum management process. Some of these are discussed below.

Consumer impacts

With the high amounts of money collected by the FCC during its PCS license auctions, many administrations are of the opinion that current fee-based spectrum prices are too low.[xvi] In many cases, these "administrative prices" were set to recover only the direct costs of the licensing effort.

There is a prevailing view that higher prices can be charged to licensees with no negative impact on consumer prices; i.e. that higher spectrum prices will simply lower the operating profits of the licensees. In the US, as auction prices have increased, the price to the consumer have in fact decreased.

Consumers can also be protected by other means. Auctions or bidding (in a case of a hybrid licensing process) can be conducted where the winner is determined based on "points" rather than dollars. In a "points" formula, bidders could gain higher scores by setting lower tariffs, for example.[xvii]

Nature of the license

For there to be a resource rent which can be extracted from an industry, there must be a positive value in using the resource. Hence the concept of charging a rent for use of a resource is intended to transfer the "excess" value from the user to the people (as proxied by the government).[xviii]

A parallel is sometimes made with mining rights, wherein a winning bidder has the right to mine a particular material in a defined area. Once the license is obtained, this right excludes "competitors" from mining in the same area.[xix] If the world market price for the resource in question declines, a licensee may choose to not mine the resource and wait until market conditions improve. Unlike the mining rights example, the exclusive use of a particular band of spectrum does not necessarily guarantee that another party will not offer an identical service in the same geographic area using another band. Thus even if one could delay network implementation due to changing market conditions (something often precluded by license conditions), the value of the resource being "mined" (i.e. wireless subscribers) may simply disappear.

Wireless versus wireline competition

One philosophy underlying the setting of a price for spectrum is that the price should reflect the value of making the spectrum unavailable for other users.

If wireless service is to compete with wireline, then the costs of wireless will have to decline to a point where it is competitive with wireline. However, since wireline service is by definition a fixed service, the value of using spectrum resources to address this market could be questioned. On the other hand, given the potential synergy available if fixed and mobile services are integrated (i.e. if the consumer ultimately can use the same service for both applications), then the size of the market increases, affording greater economies of scale and scope to the licensees and ultimately lower prices for consumers.

If greater license fees were to be imposed on wireless services, then this could distort the economic equation of wireless versus wireline, even if the underlying technology of wireless declines to the point where it could be competitive.[xx] Since wireline service comes with no ongoing fees, increasing the cost of wireless licenses could distort market forces.[xxi]

Uncertainty in the amount of spectrum to be licensed

The US approach to auctioning spectrum appears to be that if the industry continues to be willing to pay, then there must be value in the spectrum. Hence the US is likely to continue conducting auctions until such time as there is no interest from bidders.

This approach appears to have some validity in the market. Prices paid for licenses have increased as more spectrum has been licensed, while at the same time consumer prices for wireless services have been declining. Cellular license values (based on prices paid for tradable licenses won in FCC lotteries) from 1985 to 1989, for example, prices increased from $12 per POP to $136 per POP.[xxii] During the same period, the average revenue per subscriber per month dropped from $186 to $89.[xxiii]

At the time of licensing, investors make a set of assumptions and evaluate the business opportunity accordingly. The more clear the licensing policy, the better the investors will be in developing estimates of potential value in exploiting the licenses.

Foreign ownership

Canada's foreign ownership restrictions keep its telecommunications services industry largely in Canadian control.

The valuations in this paper were done from the perspective of the investment required and the ultimate market penetration available, considering typical costs of capital for the licensees. Given an equal understanding of markets and investments, foreign or domestic investors should arrive at much the same conclusion with respect to the potential value of a license. On the other hand, the cost of capital of different entities, as well as their objectives, going-in assumptions and perspectives on market strategies, will be quite different. This could lead to different valuations.

In general, foreign ownership restrictions limit who can participate in a licensing process. In the interest of promoting global trade, many countries have committed to lifting restrictions as part of GATS agreements. As many countries have realized, the lifting or relaxing of foreign ownership restrictions also has a beneficial impact on economic development and on the development of the domestic industry. An influx of foreign capital brings expertise and new ideas, ultimately leading to a more dynamic domestic industry and the potential for future exports. These trends can be seen in developed countries (e.g. cable television in the UK and New Zealand) as well as developing countries (e.g. wireless services in Brazil and India).

Treatment of existing licensees

There are existing licensees in many service categories. For these parties, there will undoubtedly be a view that the license has already been paid for. Increasing fees and/or using auctioning to establish fees could provide a disincentive for licensees to make investments.

Since the business plans, and risk of their implementation, are being (or already have been) dealt with in one context, changing the rules of the game can create uncertainty. This could lead to increased costs of capital for the licensees, since relicensing would be similar to government appropriation of all or part of the value of the business.

If new spectrum is auctioned, existing licensees may outbid others because of their market power advantages if entry is prevented. Limitations on the amount of spectrum captured by existing licensees may be appropriate in order to generate a more competitive market even though the government's proceeds from the auction could be lower as a result.

Up-front payments

The problem with high up front payments is that they have the potential of increasing capital costs and risk, thus discouraging investors and delaying capital plans. One way of mitigating the possible adverse effects of large upfront payments is to permit firms to amortize these costs over the license period. There are risks in doing this, however, since advantageous financing terms can be factored into bids, increasing the amount that bidders would be willing to pay (i.e. there may be no net benefit).

Conclusions

There are many means by which governments try to receive an appropriate level of compensation for the use of spectrum. On one hand, governments can auction licenses, in which case the value paid is entirely in the hands of the bidders. On the other hand, upfront and/or ongoing fees can be set that reflect spectrum values. In this latter case, it is a complex exercise to fully understand and evaluate the amounts to be charged.

Whether governments choose to conduct auctions, or implement a hybrid approach to licensing, spectrum management has important impacts on the development of the wireless industry. These can include re-allocations of spectrum to more valuable uses, providing incentives for levels of deployment and consumer pricing, broadening coverage, introducing competition, stimulating technology development, etc.

For developing countries the issues are even more important. The development of a viable industry, and ensuring the greater deployment and availability of services at affordable prices, are factors as important (or more so) than raising money from auctioning. Hybrid approaches to licensing have proven to be effective in stimulating industry and service development in a number of countries.

The authors

LEMAY-YATES ASSOCIATES INC., based in Montreal (Canada), was founded in early 1993. We are a management consulting firm specializing in the telecommunications, wireless telephony and cable television industries. We provide services such as

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business plans, due diligence, market research, tariff development, license applications, economic and policy analysis, expert testimony, technology assessment, technical/economic regulatory support, strategy development, evaluation of investment opportunities. Robert K. Yates and Johanne Lemay are Co-Presidents of LEMAY-YATES ASSOCIATES INC.

In January 1997, LEMAY-YATES ASSOCIATES INC. completed the report "Assessment of the Market Value of Cellular Telephony, Personal Communications Services (PCS) and Enhanced Specialized Mobile Radio (ESMR) Licenses" for Industry Canada (the Canadian government department responsible for spectrum management) as part of its process of introducing spectrum auctioning. Parts of this paper are based on the work completed for Industry Canada.

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[i] Public Notice FCC 97-232 July 2, 1997; COMMISSION OPENS INQUIRY ON COMPETITIVE BIDDING PROCESS FOR REPORT TO CONGRESS Docket No. WT 97-150

[ii] Estimated from information obtained from the FCC.

[iii] Note: "$ per pop." refers to the amount of money paid for the license when spread over the population that the license covers. For example, a license costing $10,000 which covers an area with a population of 1,000 would be stated as $10 per pop.

[iv] PCS - Personal Communications Services using the 1.9 GHz mobile bands; A, B and C bands are 30 MHz each; D, E and F bands are 10 MHz each.

[v] MDS - Multipoint Distribution Services; used for wireless cable applications in the 2.5 GHz range.

[vi] WCS - Wireless Communications Services; a flexible use band in the 2.3 GHz range.

[vii] Note: It is important to realize that there could be other more "exogenous" factors in explaining the differences. For example, the C band auctions were "hyped" by many promoters and this may have inflated values. There are also questions as to the auctioning process itself. See Public Notice FCC 97-232 July 2, 1997.

[viii] Net present values of the pro forma business plans were calculated using weighted average cost of capital figures typical for entities in each segment of the market.

[ix] Notice No. DGRB-001-96 Review of the Comparative Selection and Radio Licensing Process - Findings, Industry Canada, February 1996

[x] In Canada, for example, many wireless licensees are required to spend a pre-determined % of revenues on research and development which has helped to boost investment by the licensees in Canada.

[xi] LMCS- Local Multipoint Communications Systems (also referred to as LMDS in the US and Australia); LMCS provides a multitude of services in the 28 GHz ranges. Canada awarded two licenses in 1996 based on a comparative selection process, but plans to auction more licenses in 1998. The existing licensees may see an adjustment to their fees, depending on the outcome of the auction.

[xii] See "International Survey of Spectrum Assignment for Cellular and PCS", Martin Spicer, Wireless Telecommunications Bureau, FCC, September 1996

[xiii] This approach would increase the fees to low value applications if the spectrum could be put to better use by other applications. In this way, spectrum could be reallocated.

[xiv] See "ERMES - Auction in Germany", Alfons Keuter and Lorenz Nett, Telecommunications Policy, Vol. 21, No. 4, 1997, pp. 297-307

[xv] See "International Survey of Spectrum Assignment for Cellular and PCS", Martin Spicer, Wireless Telecommunications Bureau, FCC, September 1996

[xvi] High bid prices in the US should not necessarily be viewed as being an industry consensus on the value of spectrum. Different bidders have different backgrounds, assumptions and objectives. In addition, the auction results are very recent; the market not yet being mature enough to confirm the prices paid. Some winning bidders have also defaulted on payments.

[xvii] A points system could also incorporate other non-monetary objectives, such as for coverage, timeframe for introduction of service, etc.

[xviii] Also, if auctions are considered, the value of the resource has to be high enough in absolute terms to make the auction worthwhile. The costs of running the auction could be higher than the fees collected.

[xix] The US Department of the Interior has auctioned tracts on the Outer Continental Shelf for oil and gas production. Parties bid for the right to explore and develop a specified tract. See FCC OPP Working Paper Series no. 16 "Using Auctions to Select FCC Licensees", May 1985

[xx] In the context of running an auction, the initial auction fee paid would become a sunk cost and thus not influence going forward investment decisions. Auctions would reduce the potential for distortion of wireless versus wireline economics.

[xxi] License fees are not the only way competition may become distorted. Cellular carriers are currently treated as if they "attach" to the wireline network and therefore they pay the cost of interconnection. On the other hand, local telcos do not charge for handling each others' local traffic. Competition is also distorted by subsidized local wireline rates, wherein local wireline services are priced below cost.

[xxii] Hazlett, Thomas W., Michaels, Robert J., "The Cost of Rent-Seeking: Evidence from Cellular Telephone License Lotteries", Southern Economic Journal, Vol. 39, No. 3, January 1993, pp. 425-435

[xxiii] Estimated from the Cellular Telephone Industry Association (CTIA), Wireless Factbook, Spring 1995

Assessing Knowledge of Telecommunications Development in the Asia-Pacific Region, 1995-1997

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1. ABSTRACT

This study analyzes papers relevant to telecommunications infrastructure and services development in less developed countries in the Asia-Pacific region, presented at the past PTC conferences from 1995 to 1997. It investigates how systematically we have been learning, what useful knowledge we have acquired and sheds some light on the future study of telecommunications development in the region.

2. INTRODUCTION

In the late 20th century, advancement of telecommunications infrastructure and services is becoming one of the most crucial topics in both public and private sectors. The ever increasing speed of technological advancements in telecommunications and communication technologies has closely linked with the restructuring of human relationships, organizations, and national frameworks.

Telecommunications and new communication technologies have brought about a number of changes to societies. The changes range from societal structure, economic framework, media structure, government's roles, employment, education, health care, city structure and culture (Marien, 1996). These changes are made possible by linking communication technologies with telecommunications networks (Baer, 1996, p. 357; Freeman, 1996, p.22). Because of the wide variety of effects and significant impacts on the existing frameworks and institutions, growing attention has been paid to the future direction and extent of development of these telecommunications and communications technologies.

Baer (1996) analyzed the economic costs of delaying key policy measures in the telecommunications sector and argued that the greatest cost of the delay is isolation from innovation and international markets. The disadvantage of being left behind can be seen, however, not only in the economic arena but also in the political, societal and cultural arenas.

The Pacific Telecommunications Council (PTC) carried out a study in 1994 that forecast both positive developments and potential problems in the telecommunications and communication technology field in the Asia-Pacific region. Survey participants in the region unanimously pointed out that the biggest problem in the coming decade would be slow telecommunications development in less developed countries. They worried that slow development would cause problems in overall development of the global information network (Wedemeyer, 1994). That study aimed at removing some of the uncertainty surrounding the region's future so that desirable developments could be promoted and undesirable consequences could be inhibited.

Considering that the above problem has been regarded as very pressing and cannot be resolved over a short time period, it will be of importance to continue to accumulate useful knowledge to cope with it. This study will investigate how systematically we have been learning and what useful knowledge we have acquired.

This study will analyze papers relevant to telecommunications infrastructure and services development in less developed countries, presented at a conference in the region. The objectives of the study are to: 1) find out how comprehensively the issue of telecommunications infrastructure and services development in less developed countries was addressed; 2) examine what useful knowledge were provided; and 3) shed some light on the future study of telecommunications development in the region.

3. METHOD

As part of a larger project, this study will look into the collective output of study papers related to telecommunications development in less developed countries published in the PTC annual conference proceedings from 1995 to 1997. The PTC annual conference has increasingly become an important platform for knowledge and information exchange among a variety of telecommunications professionals, government officials, business people and academics in the Asia-Pacific region. Thus, study papers presented at the PTC conferences constitute a useful information resource. The time frame of the three years is determined because the PTC forecasting study was carried out three years ago, in 1994, and also because this study is to attempt to review the most up-to-date information on the issue reflecting the rapid changes of telecommunications scenes in the region.

This study will focus on telecommunications development in less developed countries. It will examine who investigated the problem, what facets of the problem were studied, how those facets were examined, what conclusions, if any, were drawn, and what knowledge was learned.

While all papers in the proceedings addressed telecommunications-related issues, this study selected papers more directly focusing on telecommunications development in less developed countries, that is, in the non-OECD countries of the Asia-Pacific region. The 1995 proceedings contains 15 such papers, the 1996 proceedings has 24 papers, and the 1997 proceedings includes 24 such papers. This study will analyze contents of these 63 papers.

4. OVERVIEW OF THE PAPERS

4.1 Authors

The distribution of the authors is presented in Figure 1. Among the 63 papers, 18 papers (29%) involved authors from academia. Thirteen were based in the United States and five were from Hong Kong, Singapore and Thailand. Authors of the remaining 45 papers (71%) were telecommunications carriers, consultants, researchers, lawyers or project managers in the private sector. A couple of regulators in one Asian country also contributed. Fourteen were from the United States and 31 papers were from such Asia-Pacific countries as Australia, Hong Kong, India, Indonesia, Japan, Singapore, South Korea, Sri Lanka and Taiwan. It is thus seen that more academics from the United States and more practitioners (i.e., non-academics) from the region studied and addressed the issue.

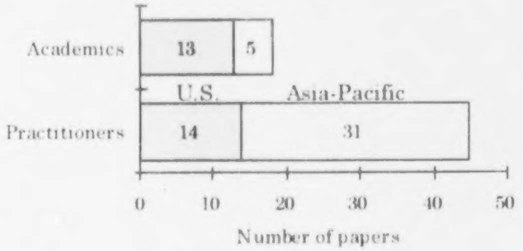

Figure 1 Authors

Collectively, about 50% of the knowledge was provided from the authors based in the United States and the other 50 % came from countries in the region. This distribution may be partly due to the fact that PTC is held in the United States. Given that the issue is the most crucial for some of the Asia-Pacific nations, however, more contribution from the region would definitely be desirable.

4.2 Nine Facets of the Development Issue

While a wide range of topics relevant to the issue of telecommunications infrastructure and services development in less developed countries was discussed from different points of view in the papers, those topics were categorized into nine groups based on what facet of the issue was the focus in each paper. The grouping and the proportion of each group are shown in Figure 2. Since some papers addressed more than two facets, the total number of papers became 82 in the figure.

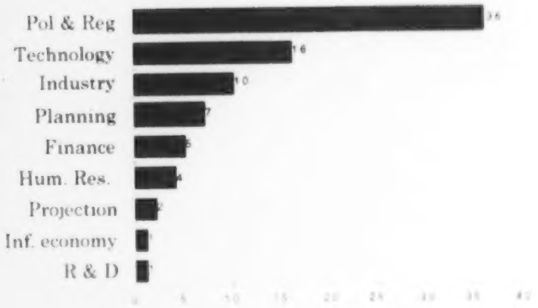

Figure 2 Nine Facets of the Issue

The most heavily studied facet was policy and regulation of the telecommunications sector and/or industry in the concerned countries. Thirty six papers (44%) focused on this facet. Most of those papers dealt with the on-going telecommunications reforms including privatization, competition and foreign companies' participation. A few other papers among the 36 studied strategies for rural network development, the institutional context surrounding a telecommunications reform, visions of APII (Asia Pacific Information Infrastructure) and GII (Global Information Infrastructure), and the Internet regulations.

Sixteen papers (20%) dealt with the technology facet. Among topics were the architecture of broadband networks and/or data networks, intelligent management systems of networks, undersea cable installation projects, and wireless systems.

The third facet was industry. Ten papers (12%) outlined the industry status in either a single country or several countries in the region. Most of them discussed the market of certain services such as cellular and VSAT, and a few discussed the status of telecommunications services in general.

Seven papers (9%) were grouped under the planning facet. A majority of these papers emphasized the importance of the strategic planning for telecommunications reform and/or telecommunications projects. Five papers (6%) discussed the finance facet of the issue and provided some advice. Four papers (5%) addressed the human resources facet such as technology transfer and/or training methodology. One or two papers discussed such facets as growth projection, information economy and research and development, respectively.

To repeat, the distribution of the nine facets clearly shows that significantly more attention has been paid to the policy and regulation facet of the problem.

4.3 Geographical Scope

Thirty seven papers (59%) chose a single country as the geographical scope of this study. The countries most studied were China and Indonesia. Nine papers on China focused on either the policy and regulatory facet or the industry facet. Five papers about Indonesia outlined the technology facet and planning facet instead. This contrast may reflect the attention to different facets of telecommunications development in these two countries.

The other countries dealt with were Hong Kong, India, Malaysia, Mexico, Palau, the Philippines, Singapore, South Korea, Sri Lanka, Taiwan, Thailand, and Vietnam. The number of papers discussing these countries was, however, only two or three respectively. More papers about these countries would be desirable to understand them from multiple perspectives. There is a need for papers on other missing countries in the region, including many of the Pacific islands countries.

Three papers (5%) studied more than two countries. Two of them focused on Pacific Island countries and one of them dealt with Latin America. Fifteen papers (24%) discussed telecommunications develop-ment related issues at the global level without referring to any specific country or region.

4.4 Study Questions

Only three papers presented their study questions at the outset of the paper. Most other authors started outlining, describing, assessing, examining, or reviewing the topic concerned and ended with a summary of the discussion. While there is no doubt that studies taking the latter approach can be informative, this study found it difficult to synthesize knowledge by consolidating information and/or isolated facts from those papers. Future conference papers can increase their contributions by stating simply and clearly the study question or problem at the beginning of the paper. Kerlinger (1986) states that "... adequate statement of the research problem is one of the most important parts of research," and that "Questions have the virtue of posing problems directly" (pp. 15-17).

Learning of facts can be easily achieved by reading or listening to information about the facts. Learning about an issue, however, is more productive when searching for answers to the problem. If a paper is to tackle the issue of telecommunications infrastructure and services development in less developed countries, it needs to clarify the problem in question and then to provide answers to it as straightforwardly as possible.

4.5 Approaches to Topics

Reflecting the tendency of developing a paper without posing a clear study question, only five papers (7%) took the preferred problem-solution approach in which some problems relevant to telecommunications development were identified, analyzed, and then solutions were proposed. The proportions of the four approaches are summarized in Figure 3. Since six papers used two approaches, the total number of papers became 69 in the figure.

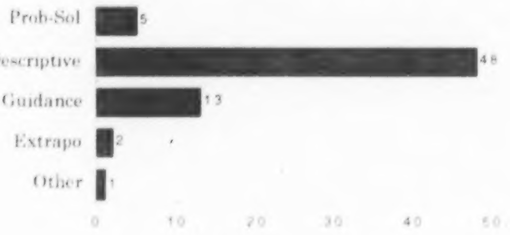

Figure 3 Four Approaches

A majority of the papers took a descriptive approach to the topic. Some papers described certain policy, plans, regulations, reform process, or telecommunications infrastructure and service status in a single country or in selected countries. Others outlined certain technology, market environment, or specific project. A descriptive paper can be a good informative resource for the topic studied, and in that sense, these 31 papers enhanced our understanding of the topic. One common shortcoming of these descriptive papers was, however, that the description was too closely entwined with the unique context or condition of the country studied to provide externally applicable lessons for other contexts and other countries. Readers of a descriptive study hope to extrapolate lessons or insights for their own countries. Thus, authors of descriptive studies can enhance the importance of their work by discussing implications and application of their studies to other contexts and other countries.

Why do lessons need to be learned from conference papers? The PTC forecasting study in 1994 identified that for the coming decade the issue of greatest concern in the Asia-Pacific region would be the slow telecommunications development in less developed countries. Why did most of the survey participants in the study point out this issue? The fact that they had not yet found appropriate solutions to the issue puzzled them.

Any study addressing this issue should contribute to solutions applicable to most of the countries suffering from that problem. Even though concrete solutions cannot be provided in a single study, at least some lessons that might be helpful in a collective way need to be provided.

Thirteen papers (19%) took an approach of providing guidance to some targeted people or entities. The advice included a methodology to estimate demands, the planning of a corporate private network, a project formation, and strategic planning for a privatization process. Most of these papers were presented by authors from the private sector. Two papers (3%) took an extrapolation approach and discussed projection of growth potential of telecommunications services and infrastructures in selected countries.

4.6 Implications of the Papers

Most of the papers, which chose a single country as their geographical scope, did not discuss implications of their study. Those papers were complete by themselves. The main focus of those papers seemed to inform readers of what was going on in the policy or regulation arena, the technology arena, or the industry in that country only.

The authors of those papers may well have assumed that their readers could easily derive useful knowledge from the papers. That assumption might hold true for a few people , but not for most readers. If a study is done to provide readers with something new as well as useful, the usefulness should be clearly depicted in the paper. An accumulation of such explicitly constructive papers will definitely contribute to our knowledge on the issues concerned.

Papers addressing issues at the regional or global level tended to discuss implications of the study. This does not mean that the larger the geographical scope of the study is the more likely its implications are presented. Instead, the author's intentions seem to have determined the extent of the implications of the paper.

4.7 Conclusions of the Papers

Four types of conclusions were observed in the 63 papers as presented in Figure 4: no conclusion, suggestions, projection and caution. Thirty seven papers (59%) did not offer any definite conclusions, but simply reiterated what had been discussed in the previous sections of the paper.

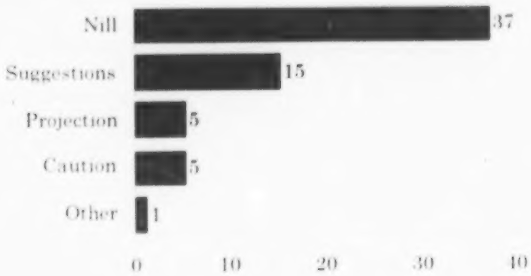

Figure 4 Types of Conclusion

The second type of conclusion was suggestions. Fifteen papers (24%) offered suggestions as part of their conclusion. One paper called for a greater extent of foreign participation in China. Three papers suggested the introduction of privatization, competition and private sector resources in countries in the Asia-Pacific region. One case study in Taiwan suggested that policy makers put more effort on human resources development and infrastructure development. A study in Thailand suggested that the government give a higher priority on strategic planning. One paper suggested the establishment of a new mechanism for regional cooperation for APII. One paper argued for building of learning alliances in order to close the telecommunications development gap. Two papers suggested frameworks to understand problems of the slow telecommunications development and to figure out possible solutions. Two papers emphasized the importance of understanding institutional arrangements in telecommunications development. Although these 15 papers were identified under as "suggestions" type, actually the statements of suggestions were buried in a sentence or a paragraph in the paper and were not so explicit.

The third type of conclusion was projection of the occurrence of some kind of events or conditions in the near future. Five papers (8%) were identified in this type. Some examples of those projections were further liberalization in Taiwan, more participation of private companies in telecommunications reform in Sri Lanka, a promising opportunity in Latin America, and prospect of a new R & D strategy in South Korea.

The fourth type of conclusion was a statement of caution to government policy makers and/or to a nation itself. Five papers (8%) were in this type. In China, the lack of policy and technology coordination in developing the Internet was pointed out as a major obstacle and it was cautioned that the current policy environment would fragment the national development effort. At the regional level, one paper argued that only those countries with an attractive regulatory and operational environment could bring in necessary capital.

5. SYNTHESIZED KNOWLEDGE

The rich information in the 63 papers was examined from different angles in the preceding sections. In this section, this study will now attempt to summarize, reorganize and synthesize the information so that something useful for and adaptable to the readers' unique situation can be comprehended. The synthesized information is presented in accordance with the nine facets of the issue of telecommunications infrastructure and services development in less developed countries discussed in section 4.2. Certain facets and countries, however, will be emphasized in this section by reflecting the overall focus and coverage of countries in the selected 63 papers.

5.1 Policy and Regulations

In India, the government introduced competition not in long-distance services but in the local loop. The government avoided privatization of the government PTT which would compete with the private telecommunications operators. Another unprecedented feature of Indian telecommunications reform is the absence of an independent regulator. The government mandated that 10% of all new lines should be installed in rural areas and all villages should have access to at least a public call office by the end of 1997. The government wants to establish internationally competitive telecommunications equipment manufacturing industry, thus it encourages the licensees to install domestically manufactured equipment by allowing the world's leading telecommunications equipment manufacturing companies to set up shop in India.

In China, MPT has mainly resisted structural reform and allowances will be made for new service enterprises that meet a market need that MPT cannot immediately fill. Wireless systems is one area where private, though not foreign, equity is allowed in services operations today. Another exception to MPT's monopoly role in services is found in satellite services, managed networks and CATV. China needs to institute a consistent and enforceable regulatory regime for telecommunications services. In terms of content regulations, it is questionable whether the current control of the Internet content will be feasible and maintained for a long time. The current environment of ambiguous guidelines, arbitrary policy exceptions, and competing interests severely fragments the national development efforts.

In order to implement a competitive safeguards regime to allow the market mechanisms to work, Hong Kong's case demonstrates that important regulatory measures include: 1) the establishing of OFTA (Office of the Telecommunications Authority); 2) controlling over the numbering plan; 3) mandating number portability; 4) determining terms and conditions for interconnection; 5) the transparency of the dominant carrier's operation; 6) regulating the prices of the dominant operator; 7) keeping watch on anti-competitive behaviors in the market; and 7) facilitating access to customers.

In Vietnam, the government seems to have found a solution to overcome managerial, financial and technical problems faced by its state owned telecommunications operator. It is seeking partnership with large foreign companies who detain capital and expertise required to develop its telecommunications infrastructure through the Business Cooperation Contract (BCC), which is an agreement between a foreign and Vietnamese partner for the mutual allocation of responsibilities and sharing of product, production or losses without creating a joint venture enterprise or any other legal entity.

In South Korea, policy and regulatory restructuring is needed in addition to industry restructuring. The separation of policy from regulation, of regulation from ownership, and of ownership from management is critical. Fundamental regulatory processes and methodologies need to be critically examined. As one example, measures to prevent anti-competitive behaviors should not unduly limit the capabilities and competitiveness of operators beforehand. Further, the guidelines should not be detailed enough to eliminate room for commercial negotiations and decisions between the parties involved.

And finally in Mexico, the government will provide incentives for cellular and trunking licenses to install more rural telephones under the footprint of coverage. In Sri Lanka, the government has decided to liberalize the wireless local loop service by issuing two licenses to the private operators for an island wide service. A study in Taiwan shows that the enhancing the level of national technological capabilities leads to a higher level of national IT use and to economic development. Among technological capabilities, human resources in science and technology and telecommunications infrastructure are the keys.

For the majority of less developed countries, a strong decision-making body and a concerted governmental commitment to telecommunications development are essential to the success of any privatization reform program. In addition, a gradual liberalization is needed to ensure a successful transition from monopoly to full competition. The effectiveness and credibility of the regulatory system depends on: 1) a political process and the political system; 2) formal institutional rules (i.e., the nature of the contractual system and the property rights regime); and 3) the nature and effectiveness of safeguarding institutions like the judiciary and most importantly, the regulatory agencies and instruments. Development of an independent regulatory agency has proven crucial to the successful introduction of competition and to facilitate a level playing field for all participants. The success or failure of the agency is strongly linked to institutional arrangements (i.e., a fixed and detailed legal instrument, transparency, autonomy) that underlie the agency's operation and resources.

Governments must act to preserve competition in three areas: in interconnection and technical standards, in licensing and in tariffs. Interconnection issues should be addressed prior to the licensing of new carriers. One approach to ensure universal service is to tie the grant of license to provide service on lucrative routes with the obligations to provide basic service on remote and rural routes. The framework, with 12 categories of obstacle and 23 obstacle factors developed in one study, is of importance as a guiding tool to investigate the potential obstacles to telecommunications development in less developed countries. Furthermore, the study suggests that the existing misunderstandings of the problems between developed countries and less developed countries should not be overlooked. One study presents six key elements to form government policy for wireless telecommunication: the level of competition, the bandwidth of spectrum, the treatment of interconnect fees, the participation of foreign firms, the involvement of state owned operators, and the introduction of new wireless operators.

5.2 Technology

New wireless technology in the local loop and down-scaled cellular systems are emerging and they make flexible and affordable connections of new customers possible. The rapidly growing use of wireless technologies to provide basic telephone services brings about an opportunity for the development of a next generation operation support system.

In China, deployment of VSATs for voice has slowed down since 1995 as the result of improvements in PSTN (10 million lines/year), and in response, the VSAT market has shifted to data communications and integrated services. In Indonesia, the network management problem of connecting multiple types of switching was resolved by first making a conversion protocol for X.25 and then by developing and implementing a standard interface recommended by the ITU to create the Integrated Management System (IMS). The study on Palau's inter-island fiber optic system provides solutions to a short-cable installation with numerous shore landings in remote places in shallow water.

5.3 Industry

In the current Asia-Pacific market where a capital seller can choose the most prospective buyer, only those countries that provide an attractive regulatory and operational environment are going to attract the necessary capital.

China's telecommunications market will become the largest in the world in years to come. Paging and cellular have expanded greatly. Wireless Local Loop (WLL) has a great potential to grow considering China's unused switching capacity. Equipment supply is the hottest area for foreign companies. In China, foreign VSAT vendors, by localizing product design and manufacturing, have demonstrated that technology transfer is key to winning the market in the long run. Especially, joint venture has been taken as the most effective means for technology transfer.

Some of the future growth prospects of VSAT are: VSAT video will be the next growth area; VSATs can be a viable contender for national and local network solutions; VSATs are appropriate for rugged terrain and dispersed population; and MSS and PCS are expected to open new markets for VSATs.

5.4 Planning

In Indonesia, efforts have been centered on three main goals: expanding customer access; modernizing public networks; and, introducing advanced services. Along with N-ISDN, TELKOM plans to commence Intelligent Network Services in early 1996.

Privatization is becoming a global phenomena and is increasingly competitive. Telecommunications operators can offer different incentives and messages to global investors. It is therefore critical that a nation manages its privatization process strategically to attract investors.

The ability to learn fast and learn together with diverse global partners is potentially the golden key for emerging and developing countries. Learning organizations pay attention to at least five component disciplines. They are Shared Vision, Personal Mastery, Mental Models, Team Learning, and Systems Thinking.

Several factors need to be taken into account in planning a successful financing of telecommunications installation projects. They are: Participants; Their commitment; Government license and consent; Government other support; Structural fluidity; and, Inter-creditor arrangements.

5.5 Finance

New private sector telecommunications operators need to prepare sound commercial plans to gain adequate financing. The new operator can achieve this by: 1) selecting an experienced operating partner; 2) paying as much attention to commercial strategy as to technical strategy; 3) overcoming regulatory shortcomings; and, 4) developing a diverse financial strategy.

The sources of private capital are sales, concessions and market entry. One type of sale is the sale of shares to the public or to strategic investors through a bidding process. Another type may involve setting up a state-private consortium or a private consortium to undertake stock or assets.

Public/Private investment partnerships can make it possible to allocate the funds of each group of investors to the specific objectives of each participant. For example, development bank funds can be targeted at supporting regulatory reform and increased government transparency. Private and governmental funds can be used to assist privatization and infrastructure development.

6. TOWARD A MORE SYSTEMATIC LEARNING

This study looked into the designs, methods and contents of the 63 papers relevant to telecommunications infrastructure and services development in less developed countries with the aims of finding out how comprehensively the issue had been addressed and of examining what useful knowledge had been provided.

While certain knowledge could be derived from them as presented in section 5, a diversity of approaches to the issue made it harder for readers to grasp any collective knowledge. Thus it may be necessary to study the issue in a more systematic and comprehensive way. Several suggestions for this direction are presented below.

First and foremost, those who study the issue of slow telecommunications development should aim at providing information useful to solve the problem and should make that aim explicit in the study. Even if the study deals with a single country, it needs to look at the bigger picture of telecommunications development at the regional or international level and should try to link the study to that bigger picture.

Second, the study should digest the nature of the problem, identify what facet of the problem should be examined, and make it clear why that examination is important. To facilitate this process, a clear statement of a study question is the first step to take. In general, learning takes place by asking questions and finding answers to them. The same rule holds true for papers for the sake of the readers' learning.

Third, though related to the second point, it is suggested that more papers take a problem-solution oriented approach to the issue. When the study takes a descriptive approach instead, it needs to relate the description of the topic to the bigger issue in the region as well.

The problem of slow telecommunications development cannot be resolved over a short time period, but many workable solutions that could be adapted by others have been experimented and/or implemented in many parts of the region. A more synthesized approach to knowledge building from these experiences is definitely needed in the filed of telecommunications development.

REFERENCES

Baer, W. S. (1996). Telecommunication Infrastructure Competition: The costs of delay. In W. H. Dutton (Ed.), Information and Communication technologies: Visions and Realities. (pp. 353-370). Oxford: Oxford University Press.

Freeman, C. (1996). The two-edged nature of technological change: Employment and unemployment. In W. H. Dutton (Ed.), Information and Communication technologies: Visions and Realities. (pp. 19-36). Oxford: Oxford University Press.

Kerlinger, F. N. (1986). Foundations of behavioral research (3rd ed.). Fort Worth: Harcourt Brace Jovanovich College Publishers.

Marien, M. (1996). New communications technology: A survey of impacts and issues. Telecommunications Policy, 20(5), 375-387.

Wedemeyer, D. J. (1994). Emerging developments analysis: Telecommunication in the Pacific Hemisphere, 1994-2004. Unpublished paper. Hawaii: Pacific Telecommunications Council.

BIBLIOGRAPHY

PTC'95 Proceedings:

Anderson, D., & Heller, M. Wireless platforms for developing nations: proliferation drives next generation of support systems. 405-411.

Brillson, P. V., Daffner, G. Telecommunications deployment in a converging world: An examination of infrastructure and regulatory strategies in the Asia Pacific region. 551-556.

Dube, V. L., & Partono, R. The installation of knowledge. 569-572.

Gilbert, A. L., Neo, B. S., & Soh, C. The evolution of telecommunications as a strategic element in the national information system: Three eras in the development role of telecommunications in Singapore. 445-452.

Kim, H. Korea telecommunications reform: The third round hitting the mark?. 557-563.

Kularatna, A. D. V. N., Gunawardana, G., Williams, C. Value added services and private sector investment in new telecom projects in Sri Lanka. 440-444.

Ogden, M. R. Widening the chasm or closing the gap? Converging information technologies & Pacific island Microstates. 592-599.

Olmer, L. H. Privatization, competition and the development of telecommunications in the Asia-Pacific region. 459-464.

Parker, P., Owen, A., & Kelly, M. Financing new telecommunication systems as competition increases. 661-665.

Petrazzini, B. A., & Bui, T. X. Vietnam telecommunications: On the road to reform. 111-118.

Rao, J. R. Telecom investment and tariff strategies in India. 101-109.

Savage, J., & Maddox, W. Looking at Latin America: Analyzing the region's telecommunications development and growth. 95-100.

Shina, N. Regulating telecommunications in developing countries: An institutional analysis. 370-377.

Tan, Z. China's information superhighway: What is it and who controls it. 600-606.

Zita, K. The policy of exceptions: Liberalization of China's telecommunications service market. 295-299.

PTC'96 Proceedings:

Au, M. H. Developing competition in local fixed networks in Hong Kong. 635-642.

Bharadwaj, B. N., & Srivatsava N. K. Evolution of information networks and future trends in India. 144-151.

Chen, S. Y., & Tsai, D. Network construction plan for NII in R.O.C. 662-668.

Cho, W., & Lee, B. W. Preparation for new information society: From regional cooperation to domestic development in the Asia-Pacific region. 453-458.

Chowdary, T. H. reforms in the Indian telecom sector. 308-312.

Gilbert, A. L. Wireless infrastructure in Vietnam: Evaluating an emergent leapfrog strategy. 62-70.

Griffith, K. A. Enhancing Mexico's information infrastructure. 128-130.

Houghton, J. W. Growth and opportunity: telecommunications services markets in APEC countries. 484-494.

Kelly, J., & Booth, L. telecom alliances for emerging economics: Breaking the cycle of under-development through strategic learning alliances. 327-332.

Kularatna, A. D. V. N., Gunawardana, G., Wickremasinghe, P. M., Wijesundera, L. Recent developments related to new telecom services, private sector participation and regulatory policies in Sri Lanka. 505-512.

Landau, D. privatization: A strategic management perspective. 298-307.

Lindley, R. A., & Hossain, L. Strategic network challenges: The case of public network planning and practice in Thailand. 206-212.

Mariano, J. J., & Rye, K. E. Palau lightnet 2000: A telecommunications revolution in an emerging nation. 131-138.

Okamura, N. H., & Durand, E The Pacific telecommunications and information infrastructure: Leap-frog or widening gap?. 934-947.

Olmer, L. H. Financing the global information infrastructure. 984-990.

Ono, R. Critical obstacles to telecommunications development in developing countries. 280-289.

Parker, P., Owen, A., & Myles, A. Future directions for telecommunications in Thailand. 669-673.

Petrazzini, B. A., & Clark, T. H. Evolving telecommunications regulatory regimes in developing countries. 627-634.

Salvaggio, J. L. China's emerging telecommunications infrastructure: Market analysis and social impact. 815-820.

Shinha, N. The political economy of India's telecommunication reforms. 920-927.

Simpson, A. C. The impact of wireless local loop technologies in Asia-Pacific Market. 46-53.

Tan, Z. Internet in China: Growth, competition and policy. 621-626.

Udaka, M. Financing for development of telecommunications infrastructure: Various means to accumulate capital for constructing and enhancing telecommunications networks in Asian economies. 1004-1011.

Widjajanto, B., Sutanto, A., Rukandi, D., Supriyo, Susilowati, E., & Sutisna, A. Telkom Indonesia: A strategy between networked-based and service-based expansion. 791-798.

PTC'97 Proceedings:

Ahmad, A. VSAT applications advance as Asia liberalizes. 61-63.

Arena, A. A. Telecommunications developments in the years ahead. 122-127.

Bernard, K. Hong Kong update. 128-138.

Boyd, J. A. & Sharp, D. S. Alternatives for establishing viable rural networks. 296-303.

Chung, K., Choi, S. H., Park, G., & Kim, K. A new strategy for nation-wide research and development under competitive information and telecommunications environment in Korea. 196-200.

Crowe, T. K., & Ecret, D. Impact of the Telecommunications Act of 1996 on the Pacific Rim. 649-659.

Fan, X. Heading towards "Informatization": China faces dilemmas and challenges. 456-462.

Gerstell, G. S., & Mansion, D. A. Structuring a financeable telecommunciatins installation project. 270-276.

Harwit, E., Clark, D., & Su J. Deregulation of China's telecommunications industry: The case of China Unicom, Inc. 546-550.

Hong, R. K. Telecommunications in the PeopleÕs republic of China: The present status and future development. 440-449.

Hsu, K. W. W. New era for Taiwan's telecommunications market and foreign telecommunications services providers. 660-667.
Hudson, H. E. Restructuring the telecommunications sector in Southeast Asia: policies and pitfalls. 87-98.
Jussawalla, M., & Taylor, R. D. Is the information economy a sine qua non for economic development. 287-295.
Lemay, J., Yates, R. K., & Baril, G. The impact of wireless telecommunications on universal access in emerging countries. 241-246.
Mariano, J. J., & Rishar, D. implementation of the Palau telecommunications undersea network. 592-600.
Ono, R. Worldwide probe of the telecommunications development gap from developing country and developed country perspectives. 1-25.
Poon A. Internet services in Asia: The rapid emergence of competition and regulation. 636-638
Roe, K. K. Overview of opportunities in China's wireless market. 450-455.
Sarwano, W,.& Susilowati, E. TELKOM's approach to interconnect switching into integrated management system (IMS) in broadband era. 108-112.
Sun, L. VSATs in China: technology, applications and growth prospects. 71-80.
Sutanto, A., Purnomo, A. H., Huhammadiah, I., & Marsono, S. PT. Telekomunikasi Indonesia: Toward broadband infrastructure and reaching the national prominence. 175-179.
Wang, E. H. H. Taiwan's strategies for IT-led development and NII: A longitudinal study. 277-286.
Widjajanto, B. & Peranginangin, N. Expansion of the intelligence network to support nation-wide services: An Indonesian perspective. 429-433.

How to Build an Information City:
A Case Study of the Hays USA Information City Initiative

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> But this is that which will indeed dignify and exalt knowledge, if contemplation and action may be more nearly and straitly conjoined and united together than they have been.
>
> Francis Bacon, 1605 (1)

ABSTRACT

This paper presents a report and case study of the "Hays USA: Information City Initiative." It shows how a midwestern USA city is adapting to the complex, transforming environment of the information economy in the global knowledge society. This paper examines the factors that encourage the development of information cities, and warns of drawbacks that impede the potential for growth into this new environment. The author provides conclusions and recommendations for community leaders, researchers, information architects and telecommunications vendors to assist in developing information cities around the world.

1. INTRODUCTION: THE COMPLEX INFORMATION ECONOMY DEMANDS COMMUNITIES ADAPT

The information economy is here, now. It is the driving component of and a reflection of the knowledge society. Peter Drucker calls this era "the age of social transformation." It is a complex era. Complexity theory(3) and common sense warn us that communities that want to thrive, here and now, must adapt.

We already may know that, in theory. Yet as Francis Bacon wrote in 1605, living in the complexities of the English Renaissance, what we know is dignified and exalted if we can "more nearly and straitly" conjoin and unite theory–"contemplation"–and action. And as a warning of how old the problem is and how hard it is to join them together, he gently chides and calls for uniting them more together "than they have been."

Therefore the challenge for communities, and the thesis of this paper, is how to build an information city appropriate to the knowledge society. This paper presents a report and case study of the "Hays USA: Information City Initiative." The paper shows how a midwestern USA city is adapting to the complex, transforming environment of the information economy in the global knowledge society.

In a far-sighted move, the City of Hays, a community of about 21,000 people on the Great Plains of North American in western Kansas, declared several ambitious goals in its 1994 Strategic Plan:

> Hays will be a city with special adaptation and skill in using information in networks to increase economic, cultural, medical, and educational opportunities. Hays will contribute to our regional community through leadership as an "Information City."
>
> The City of Hays will be a community where knowledge is valued with lifetime education and the sharing of knowledge understood to be the means of instilling that value.

To realize this vision, the City mobilized a task force to make recommendations on how to build itself into the information city it saw as its role. Enthusiasm drew 120 information professionals to the effort. A community-based organization evolved, named the Information City Advisory

Group (ICAG). Under the direction of a 20-person steering committee, with executive leadership provided by a "four-wheel drive" team of four ICAG Co-Chairs (called the "C-4 Panel"), the organization set forth a remarkable *Agenda for Action* for the community. It opens with this preamble:

> We believe that an *Information City* is created by, for and of, *Information Citizens*. An Information City, then, is built through *Information Citizenship*. An Information City will provide an environment where an Information Citizen can flourish. Information Citizens use information, information networks, and information technologies to improve their quality of life as well as the lives of their neighbors. Information Citizens expand their horizons through information sharing. Information Citizens have a passion to use information to serve the greater whole.(4)

This is the charter of a community positioning itself to survive and thrive in the information economy that increasingly drives the knowledge society of our era. The long-term strategic vision and short-term practical steps taken by this Kansas, USA, community can serve as a model for others throughout the world.

Hays USA is a small town in a geographically-isolated rural environment. Its *Agenda for Action* focuses on five key areas that can transform a community through the imaginative use of information: civic & cultural; economic development; education; health care; and human services. The Hays USA Information City experience can be transferred into similar places and parallel cultures such as Pacific island communities, rural Asian and American towns, and enclave cultures worldwide.

Here is the Information City Advisory Group's strategic vision, from the initial *1996-1997 Agenda for Action* :

The Long Term Vision for Hays, USA: An Information City

Civic & Cultural - Information Citizenship will preserve and enhance the quality of life in Hays and also provide Hays citizens opportunities to become worldwide citizens through information exchange.

Economic Development - Information Citizenship will bring about a balanced regional economy with emphasis on knowledge work through good paying jobs and prosperous businesses.

Education - Information Citizenship will allow Hays to continue developing its position as a leader for the delivery of educational opportunities and services throughout the community, region and state.

Health Care - Information Citizenship will sustain Hays as the leading regional health care community by ensuring accessibility to up-to-date medical information, continuing to attract top professional health caregivers and by empowering patients with the knowledge for preventative self care.

Human Services - Information Citizenship will provide the framework to support the information sharing necessary for people to take care of one another.(5)

The long term vision in each area led to a set of five Action Item goals, for a total of 25 Action Item goals for the community. For quick reading, these were abstracted and listed together, by area, in a two-page spread in the *Agenda for Action* 12-page summary document. The complete *Agenda for Action* carried appendixes with extensive reports from each of the five task forces, which outlined the deliberations, research and conclusions that led to the Action Item goals.

Finally, the Information City Advisory Group (ICAG) produced a set of five immediate "Short Term Goals," essentially representing each of the five areas of emphasis. Guidelines for these representative goals were that they were reasonable, reachable, and practical, to demonstrate a first year's results of the experiment for the initiative:

The Short Term Goals for Hays, USA: An Information City
July 1996 - June 1997

ICAG believes that the first step to Information Citizenship is Information Literacy. Therefore, Information Literacy will be measured, via public surveys, the first year by:

10% of all computers in Hays will be connected to networks (on the Internet or local area networks.)

10% increase of citizen usage of the Hays Public Library Internet computer terminals.

50% of all new jobs in Hays will be information-related jobs.

10% increase of citizens having electronic mail (Email) addresses (on the Internet or local area networks).

10% increase in non-traditional student enrollments (outside ages of 18 to 22) in area classes.(6)

The information city initiative met each of these short-term goals in the first year. The ICAG next developed a second, less extensive ***1997-1998 Agenda for Action*** which is currently being carried out. While the project and community experiment is still underway, we can already discern some overall benefits of success, and potential drawbacks of failure.

2. BENEFITS OF SUCCESS; DRAWBACKS OF FAILURE

The Information City initiative represents a classic trade-off of benefits and drawbacks to the community. The trade-off is even more acute for the cadre of information professionals and influence leaders who drive the effort, bear the burden of the work, and who gain only indirectly by success, since it is the community as a whole that most benefits. For the leadership cadre, the effort illustrates Mark Twain's conclusion about the pursuit of the Holy Grail: "there's worlds of reputation in it, but no money."(7)

On the one hand, the community benefits are a package worth pursuing. Rural areas in Kansas and worldwide face significant challenges in moving off natural-resource economies. Alternatives such as tourism, travel hospitality, and regional trade can contribute important streams of outside revenue and cultural exchange. But the jobs and community experience from those activities are often relatively low-wage and low-skill. And significantly, the competencies they call for are not necessarily new knowledge-value-added the community needs for its future. Thus an information-community approach appears beneficial and truly innovative.

On the other hand there may lie ahead unforeseen drawbacks. Consider the question posed in the article title "The Informatization of Japan: Creating an Information Society, or Just Good Salesmanship?" Jonathan M. Jaffe, in his study of Japanese government initiatives for the "informatization" (*Johoka*) of the country, warns that such an effort may emerge as merely a cynical recasting of conventional economic and development approaches, wrapped in new packaging.(8)

Another view of drawbacks comes from British analyst Mark Hepworth, in a forward-looking article titled "Information Cities in Europe 1992." He locates five potential "areas of concern" from the development of "structural change and local policy initiatives" of information cities:

1. Labor force social polarization (growth in information *and* lower-order service occupations; education inadequacies hampering labor mobility and supply)
2. Interurban competition diversion of public authority and finance "towards major economic development initiatives whose benefits may flow to consumers and firms respectively living or located outside the jurisdiction."
3. City-imposed charges for previously-provided information services–a form of regressive taxation on lower-income groups.
4. Intense rivalry between cities threatens waste of public information technology resources, when in fact intercommunity linkages and alliances are required, especially for infrastructure development.
5. Spatial centralization of economic power that marginalizes less-favored regions(9) ("the 'Euromegalopolis' concept").(10)

Nevertheless, there are significant benefits, particularly for communities that are facing imminent changes of conditions, such as cutbacks of agricultural subsidies; natural resource commodity shifts; or population migration in or out. Based on the Hays USA experience, below are summary analyses of the benefits of success and drawbacks of failure of the information city initiative:

2.1 BENEFITS OF SUCCESS

- Community survival and prosperity through adaptation.
- Increase in the community's quality of life (through mobilized knowledge power).
- New source of good jobs, that have strong career paths.
- Attraction of the information economy professionals that the community sees as its future.
- Adds to diversity of local economy (spreads resource base and adds growth area).
- Most important: building community competencies (knowledge, skills and attitudes).

2.2 DRAWBACKS OF FAILURE

- Diffusion of community effort into a difficult morass of complexity too new to be well-understood anywhere.
- Reputations and community influence of many professionals and some political leaders are at risk in the visionary proposal they present, and represent, to the citizens.
- Increase in citizen cynicism, fear, illusion of powerlessness in the face of change if the project fails; if the Imperial Guard is thrown back, the battle of Waterloo is lost.

3. COST-EFFECTIVENESS OF THE PROJECT

- Because a volunteer effort, cost to the taxpayers has been minimal.
- Real cost has come from the work time donated by information professionals across the community; in turn they have benefited from increased professional interaction through common community projects.
- Project catalyst has brought information professionals into the forefront of community public policy as resident volunteer consultants pro bono, without consulting fees. The advisory group estimates hundreds of thousands of dollars worth of professional time have been donated to the community through the initiative.

4. RESULTS OF THE EXPERIMENT

- New information-based computer services company located in community–300 new, skilled jobs.
- Ellis County Internet home page developed; Information City home pages developed.
- Fifteen local Internet service providers (ISPs) doing business in the community.
- City of Hays beginning to serve as a model for other communities–inquiries answered and presentations being made which enhance the City's reputation.
- Focus on whole-community strategy is successful; "width of participation versus spike of innovation" approach works.

Sykes Enterprises Incorporated moved to Hays with 300 jobs. Hays and the State of Kansas provided significant incentives in a effort led by Mark Bannister of Fort Hays State University, building on a strategy outlined pro bono for the community by Dr. William Charland, a widely-published workforce consultant and Senior Fellow of the Center for the New West in Denver.

The fifteen ISP organizations in Hays are nearly half as many as in the metropolitan Seattle area, and compare to 24 ISP organizations in metropolitan Kansas City. This is a remarkable level of Internet service activity in a town of 21,000 people.

5. HOW TO BUILD AN INFORMATION CITY

Key theoretical concepts (Bacon's "contemplation") must be united with action to build an information city. First, the city must *work* as a community. At the foundation, "community" means "share together." A community shares the work. Therefore a community organizes.

Even though the size of this particular community seems to be on an understandable, "human" scale, we found that the city is fundamentally complex.

The local experience proves a key point–all communities are complex. Thus theories of complexity can help communities understand and develop themselves by *recognizing complexity, adapting to it, and tolerating the uncertainties of real innovation and the unclear pathways to positive change.*(11)

To organize citizen action in a complex community, means a refraction of mass effort into a workable participation structure. Think of a prism refracting what appears to be one beam of visible light into the rainbow spectrum it's made from. In Hays, this kind of prismatic participation structure has worked. The deliberately large population of participants was refracted into workable teams, to carry out the actions of the information city initiative.

The process was guided by the best-practices approach of the information professionals who put it together, based on their collective experience. However, ultimately the "error and trial" method Tom Peters advocates(12) drove much of the outcome. The process worked as described below:

1. City strategic plan led to leadership initiatives from the strategic planning implementation group
2. Leadership initiatives led to a community meeting
3. Community meeting led to Information City Advisory Group (ICAG) forming
4. ICAG led to an approach characterized by "width of participation versus spike of innovation." Dr. Bob Cox, then Rural Medical Director at Hays Medical Center, introduced medical virology theory; to infect an entire community, you need 13% of population to be carriers. ICAG therefore set a membership goal of more than 200 people (currently it has reached about 120 members).The Information City Advisory Group began calling itself "The Horde."
5. Actual management group of 20 activist volunteers formed, called the "Steering Committee." Steering Committee appointed an ICAG leadership panel of four chairs called the "C-4 Panel."(13)
6. Five Task groups appointed the first year (civic & cultural; economic development; education; health care; and human services)(14)
7. Four Task groups formed the second year (community access and equipment; community education; institutional development; economic development)

6. CONCLUSIONS: FACTORS THAT ENCOURAGE OR IMPEDE FORMATION CITY DEVOPMENT

- Infrastructure development is a foundation–a necessary but not sufficient basis to build an information city
- Because of real complexity, the community must deal with uncertainty, "thriving on chaos" as Tom Peters declares. Those who can, do.
- Voluntary professional mobilization can make a difference in a community, providing the initiative for cultural change.
- Volunteerism can only begin the process. Institutionalization of the information city concept has to lead the community to the next level.
- The information city effort is scaleable; but as it can grow, so it can also shrink.

7. RECOMMENDATIONS: BUILD INFORMATION CITIES THROUGH WHOLE-COMMUNITY FOCUS

- Vendors need to participate by working with information communities to innovate as a whole community. This is different marketing than selling to an individual enterprise. Vendors must become community partners; they must in effect join the community as an information citizen.
- Researchers must focus more deeply on community innovation in the complex world of the information economy. The uncertainties need to be taken as research challenges to build an anthropology of community innovation and a sociology of information citizenship.

- Information professionals need to expand their scope, moving beyond the extraordinary intensity of their daily work to give and take as information citizens in appropriate public policy actions for their communities.

- Information architects must provide structures for information-citizen participation in the civic sector, not just the private sector and the government sector.

- Community leaders must adapt to the complexities of the information economy in a knowledge society, beyond a capital economy in the industrial society.

8. MASTER PARADOX IN COMPLEX RENAISSANCE TIMES: THE TECHNOLOGY CASINO AND INFORMATION CITY LEADERSHIP

I have previously used the term "The Information Renaissance" as a metaphor. This is meant to help us comprehend the complexities of our own era, by looking to and from the multiple eras of the European Renaissance (about 1450-1620). Those eras were characterized not just by the utility of printing and the sweetness of art that forever altered the world's contemplation, but also by history-changing actions of social dislocation, paradigm demolition, and civil war.

We find ourselves in the same kind of paradoxical renaissance time. Our era appears simultaneously bright and clouded, with peace spreading and conflict breaking out, full of opportunity and danger.

It is not enough just to contemplate the information renaissance that is unfolding. If the guiding premise of leadership is to master paradox,(15) then, through action, we must adapt masterfully to the complexities of our own era.

Brian Arthur shows us how. He adapts the paradoxes of complexity theory in practical advice to technology leaders, beginning with a striking metaphor he calls "the Casino of Technology":

> [T]he Casino of Technology requires several things: excellent technology, the ability to hit the market at the right time, deep pockets, strategic pricing, and a willingness to sacrifice current profits for future advantage. All this is not just a matter of resources but also of courage, resolution, will. And part of that resolution, that courage, is also the decisiveness to leave the market when increasing returns are moving against one.
> [. . .]
> Technology comes in successive waves. Those who have lost out on this wave can position for the next. Conversely, those who have made a killing on this cycle should not become complacent. The ability to profit under increasing returns is only as good as the ability to see what's coming in the next cycle and to position oneself for it--technologically, psychologically, and cooperatively. In high tech, it is as if we are moving slowly on a ship, with new technologies looming, taking shape, through a fog of unknowingness. Success goes to those who have the vision to foresee, to imagine, what shapes these next games will take.(16)

Those who wish to build information cities of their communities can apply almost every part of Brian Arthur's insights to their work.

It's not just about companies, it's about communities. "Those who have lost out on this wave can position for the next. . . . technologically, psychologically, and cooperatively." Communities worldwide can regain opportunities past by repositioning themselves as future information cities. "Success goes to those who have the vision to foresee, to imagine, what shapes these next games will take ."

As the poet sings, "The slow one now/Will later be fast/As the present now/Will later be past/The order is rapidly fadin.'"(17) In today's renaissance, here and now, we can build an information city. We can adapt, and thrive on complexity.

REFERENCES

(1) Francis Bacon. (1605.) *Of the Proficience and Advancement of Learning Divine and Humane* (First Book, V, 11). Reprinted in Mortimer J. Adler, Ed. (1990.) *Bacon, Descartes, Spinoza.* Volume 28, *Great Books of the Western World* (2nd ed.). Chicago: Encyclopedia Britannica, Inc., pp. 16-17.

(2) Peter F. Drucker. (1995.) The age of social transformation. *Atlantic Monthly* (November 1995).

(3) The leading economist in the complexity theory movement is W. Brian Arthur. His theoretical work in the following representative articles can add knowledge-value to the practice of information community development: Competing technologies, increasing returns, and lock-in by historical events. *The Economic Journal* 99 (March 1989): 116-131; Positive feedbacks in the economy. *Scientific American* 17 (February 1990): 92-99; W. Brian Arthur. (1996.) Increasing returns and the new world of business. *Harvard Business Review* (July-August 1996): 100-109.

(4) City of Hays, Kansas, USA, Information City Advisory Group. (1996.) *Hays USA: An information city: 1996-1997 agenda for action,* p. 4. The related 1994 Strategic Plan goals quoted above are also reprinted in this *Agenda*, on pages 4 and 6 respectively.

(5) City of Hays, Kansas, USA, Information City Advisory Group. (1996.) *Hays USA: An information city: 1996-1997 agenda for action,* p. 5.

(6) City of Hays, Kansas, USA, Information City Advisory Group. (1996.) *Hays USA: An information city: 1996-1997 agenda for action,* p. 5.

(7) In Mark Twain. (1889.) *A Connecticut Yankee in King Arthur's court.* New York: Charles L. Webster and Company.

(8) Jonathan M. Jaffe. (1996.) The informatization of Japan: Creating an information society, or just good salesmanship? *Pacific Telecommunications Review* (June 1996).

(9) I have discussed similar global hegemony issues at length in Jay E. Gillette (1996) "The information renaissance: Toward an end to rural information colonialism." *Pacific Telecommunications Review* (December 1996).

(10) Mark E. Hepworth. (1991.) Information cities in Europe 1992. *Telecommunications Policy* 15 (June 1991): 181.

(11) The City of Littleton, Colorado, USA is a leader in adapting complexity theory to the needs of community development. See Littleton's annual reports and the sections on complexity theory written by Chris Gibbons.

(12) Tom Peters. (1987.) *Thriving on chaos: A handbook of management revolution.* New York: HarperCollins.

(13) The leadership panel consisted of Brad Boyer (Sensory Perceptions Internet, Inc.).; Robert Cox, M.D. (Hays Medical Center); Jay Gillette (Fort Hays State University); Gary LeCount (Jefferson Elementary School, Hays Unified School District Number 489).

(14) Task Group Chairs were drawn from volunteer information professionals from throughout the community. Most Task Groups selected co-chairs to spread the leadership burdens and provide backup team management if one co-chair could not be available. Generally information management and systems specialists, ICAG members were characterized as "the busiest people in town." Their donation of hundreds of hours of their time was extraordinary (more than 60 meetings took place throughout the community from November 1995 through March 1996). See "Where We Came From: History of the Information City Initiative," *Hays USA: An information city: 1996-1997 agenda for action,* p. 6.

(15) Tom Peters. (1987.) *Thriving on chaos: A handbook of management revolution.* New York: HarperCollins, pp. 472-480.

(16) W. Brian Arthur. (1996.) Increasing returns and the new world of business. *Harvard Business Review* (July-August 1996): 108.

(17) This classic prophecy is from Bob Dylan, "The Times They Are A-Changin,'" reprinted in his 1973 *Writings and Drawings.* New York: Alfred A. Knopf, p. 85. For a thoughtful scenario analysis on this point, see Peter Schwartz and Peter Leyden, "The Long Boom: A History of the Future 1980-2020," *Wired Magazine* (July 1997): 115-129,168-173. The magazine's table of contents summarizes the article in this typical *Wired* style: "We're facing 25 years of prosperity, freedom, and a better environment for the whole world. You got a problem with that?" I am grateful to visionary telecommunications consultant Chris Hoy for underscoring the importance of the article to me and my students in a leadership presentation he made on 05 November 1997 at Fort Hays State University.

BIBLIOGRAPHY

Arthur, W. Brian. (1989). Competing technologies, increasing returns, and lock-in by historical events. *The Economic Journal* 99 (March 1989): 116-131.

Arthur, W. Brian. (1990). Positive feedbacks in the economy. *Scientific American* 17 (February 1990): 92-99.

Arthur, W. Brian. (1996). Increasing returns and the new world of business. *Harvard Business Review* (July-August 1996): 100-109.

Braman, Sandra. (1993). Harmonization of systems: The third stage of the information society. *Journal of Communication* 43 (Summer 1993): 133-140.

City of Hays, Kansas, USA, Information City Advisory Group. (1996). *Hays USA: An information city: 1996-1997 agenda for action.*

City of Hays, Kansas, USA, Information City Advisory Group. (1997). *Hays USA: An information city: 1997-1998 agenda for action.*

City of Hays, Kansas, USA. (1997). www.infocity.net [Hays USA Information City website]

City of Littleton, Colorado, USA. (1995). *Littleton, Colorado's new economy program: 1995 annual report.*.

City of Littleton, Colorado, USA. (1996). *Littleton, Colorado's new economy program: 1996 annual report.*.

Drucker, Peter F. (1993). *Post-capitalist society.* New York: HarperCollins Publishers.

Drucker, Peter F. (1995). The age of social transformation. *Atlantic Monthly* 274 (November 1995): 55 ff.

Ellis County, Kansas, USA. (1996). www.ellisco.com [Initial Hays USA Information City website]

Gillette, Jay E. "The information renaissance: Toward an end to rural information colonialism." *Pacific Telecommunications Review* (December 1996).

Hepworth, Mark E. (1990). Planning for the information city: The challenge and response. *Urban Studies* (August 1990).

Hepworth, Mark E. (1991). Information cities in Europe 1992. *Telecommunications Policy* 15 (June 1991): 175-181.

Jaffe, Jonathan M. (1996). The informatization of Japan: Creating an information society, or just good salesmanship? *Pacific Telecommunications Review* (June 1996).

Peirce, Neal R. (1993). *Citystates: The true economic communities of our time.* Denver: Center for the New West.

Peters, Tom. (1986). *Thriving on chaos: A handbook for management revolution.*

Sakaiya, Taichi. (1991). *The knowledge-value revolution, or, A history of the future.* Tokyo and New York: Kodansha Publishers.

Sakaiya, Taichi. (1993). *What is Japan?* Tokyo and New York: Kodansha Publishers.

Winslow, Charles D. and Bramer, William L. (1994). *Future work: Putting knowledge to work in the knowledge economy.* New York: Free Press.

Electronic Commerce Opportunities for the Telecommunications Industry

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This paper will discuss the opportunities in the electronic commerce industry for telecommunications companies.

As we all know, the worldwide telecommunications industry is changing daily. With changes in competition, regulations, technology, and cultural issues to worry about, telecommunications companies need to look at new ways to generate new customers in new markets. As the world continues into the information age, we will be exchanging vast amounts of data. To successfully manage all of this information, the proper networks, equipment and technical expertise will be needed. All of this preparation and build-up will be capital intensive, and will require telecommunications companies to acquire new revenue sources.

Of the many forms of information exchange using additional bandwidth, the fastest growing sector is electronic commerce. Electronic commerce can be defined as simply as using electronic means to transmit information between trading partners. Trading partners can be customers, vendors, divisions or departments, or any group of people who exchange information. This concept is not new, as companies have been using Electronic Data Interchange (EDI) for years to transfer electronic information. For most people today, electronic commerce is fast becoming a term that signifies an exchange of financial information. The most popular understanding is an electronic form of payment for products or service, usually in the form of credit or debit card purchases.

The industry professional, however, understands that financial electronic commerce involves accepting, transmitting, validating, processing, storing and auditing payment transactions. These transactions can include anything from a purchase with a credit/ATM/debit card, accepting credit payment over the Internet, to using prepaid phone cards and completing international monetary transfers. The one thing all of these transactions have in common is they all need some form of transmission media (telecommunication service) to complete the process.

The worldwide financial electronic commerce market was estimated at 100 billion US dollars in 1996. By the year 2000, it is expected to pass 300 billion US dollars according to some industry experts. These estimates do not include internal banking industry funds transfers.

Three sectors of the electronic commerce industry will require the availability of significant new telecommunication services as they continue their rapid growth. The prepaid telephone market is expanding at a pace that will require great expansion of residential, business and wireless service capabilities. Usage of prepaid cards continues to grow all over the world, but the advent of prepaid wireless and prepaid residential and business service will quickly outstrip the use of cards in traffic minutes. In many countries, statistics show that as many as 35% of wireless or residential service applicants are turned down for credit reasons. Prepaid products will allow these potential customers to become active consumers of service. The global prepaid telecommunications market segment has grown to an estimated 10 billion US dollars in 1997. This number is virtually all card traffic.

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On the Internet, the volume of financial electronic commerce is already larger than most people realize. Recent studies in Japan and Singapore show that 15% to 20% of Internet users buy goods and services via the Web. In the U.S. and Europe, the percentage is close to 25% for home Internet users and almost 20% for business users. In more than half the transactions, actual payment is made via the Web. Three-quarters of these transactions are business-to-business related transactions. Industry experts estimate that financial electronic commerce on the Internet will reach 1 billion US dollars in 1997, and that it will grow to 3 billion US dollars in the year 2000. This growth will be supported by sales of Internet commerce software estimated at 3 billion US dollars by the year 2000. The telecommunications industry will provide all of the new transmission services needed to allow this growth.

International electronic monetary transfers is a market segment which is also experiencing rapid growth. Today, the global market moves an estimated 10 billion US dollars in value between private parties. With the new developments in electronic commerce servers and stored value card products, new alliances between banking institutions and private companies will make domestic and international transfer of funds easier and less expensive for the end user. According to industry experts, the volume of transfers is expected to grow by 50% in the next two years.

These and other varied industry segments will be responsible for significant new demand on the global telecommunications infrastructure. The opportunities are great for companies who are able to carry traffic as well as those who may wish to participate in the growth as direct providers of service.

Native Americans' Options in the Global Telecommunications Services Industry

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For centuries Native Americans have conformed with U.S. economic development policy. They have done this with the desire to preserve language and cultural identity. Now non-conforming opportunities have emerged in electronic services that provide security and privacy with a demand from domestic and foreign clients. This paper examines Native Americans in the framework of U. S. Federal Indian Policy. It will also analyze the impact of regional and global trading in telecommunications equipment and services. Using telecommunications equipment as the base for economic growth and services as the engine for that growth.

As the next phase of the global economy takes shape in the world of information technology and change sweeps through much of the United States, Native American leaders are asking themselves whether and how the new technology can empower Native communities. Will the technology serve to bring together or further disconnect Alaskan and Hawaiian Natives from their continental and island homelands? At the time of the American Revolution, what is now the United States was home to hundreds of indigenous peoples with a variety of forms of self-government, organized at the tribal, village, or island level. Today's Native Americans—American Indians, Alaska Natives, and Native Hawaiians—are the descendants of these indigenous peoples.[1] Over the last 200 years, indigenous peoples have struggled to maintain their cultures, sovereignty, and self-determination in the face of population pressures and ever-expanding national and state governments.

The established framework of federal Indian law recognizes tribal sovereignty, a federal trust responsibility for those tribal lands and resources ceded to or taken by the United States, and a commitment to tribal self-determination over programs and services vital to tribal well-being. Federal law and policy apply this framework to the 550 federally recognized Indian tribes—including about 220 Alaska Native tribal or village governments (Indian, Aleut, or Eskimo). Federal policy on Native Hawaiians is more ambiguous, although the United States has apologized for its role in the overthrow of the Hawaiian Kingdom. A deeper analysis indicates, however, that the many parallels between Native Hawaiian and American Indian history provide a basis for defining a form of federal trust responsibility for Native Hawaiians as well.

In fact it is now conceivable that the future of Hawaiian sovereignty will determine the next phase of aboriginal issues for the mainland. A strong case for Hawaiian sovereignty can be made under international law, says professor Francis Anthony Boyle.... It is more likely, though, that the issue of Hawaiian sovereignty will become a federal question that may be answered with in the context of extensive body of laws and Supreme Court decisions governing Indian tribes in the continental United States. Those laws generally have not been applied to Native Hawaiians. How those laws might be applied in carving out sovereignty for Native Hawaiians could create important precedents for some 550 tribes on the mainland and in Alaska. With a total population of some 2.1 million, they themselves have often felt the constraints of limited sovereignty.[2]

There is also increasing agreement among sovereignty advocates that while the tribal reservation structure that exists under federal law on the mainland provides some precedent for their movement, it is not a viable model. Even Mililani B. Trask, a leading advocate of a "nation within a nation" approach that many compare to tribal status, insists she does not favor seeking status equivalent to that granted to American Indians. "The government cannot shove us into a mold for continental Native Americans," she says. "We do not want to be placed under the Bureau of Indian Affairs." The main problem, she says, is that federal law does not convey the level of political and economic self-reliance to Indian tribes that Native Hawaiians are seeking.[3]

Even though there are differences in the sovereign relationship of the various Native American groups most share very similar statistics. Over half live in rural areas, with some having the highest poverty, suicide, incarceration, and substance abuse rates in the United States. Telecommunications technology offers many opportunities to help Native Americans deepen their cultural roots, empower their communities, strengthen Native governments, and address these and other daunting challenges such as very high unemployment and poor health conditions. The promise of telecommunications is by no means assured, however. Indeed, if Native Americans, collectively, do not gain better understanding and control of this technology, the result could be to further undermine Native culture, community, sovereignty, and self-determination.

Tribal telecommunications law is in its initial phase. Precedents from Indian law suggest that those tribes that wish to assume some degree of telecommunications authority and responsibility now vested in the states and the FCC could legally do so. Some tribes may wish to operate under current authorities; others, may choose to establish their own tribal telecommunications agency or authority. A fundamental question is the extent of tribal authority over telecommunications on tribal lands (e.g., physical infrastructure) and in the air over tribal lands (e.g., frequency spectrum).

No single technological solution will address Native American needs. A variety of technologies, working together or complementing one another, will best meet their diverse needs. Computer networking, satellite video conferencing, computers and software, facsimile, digital switching, broadcast radio, cable TV, and cellular or wireless communications all have a role to play. Even the basic telephone is important because many (perhaps one-half) rural Native homes do not have a telephone today.[4]

While Native American telecommunications activities are increasing, the rate of change in the majority society has accelerated markedly in recent years. This reflects the current emphasis on the national information superhighway, and the further transition of the United States into a post-industrial information economy and society. One way for Native Americans to be proactive on the issue of Telecommunication on Native lands, calls for Native entrepreneurial activity. The formation of Native owned and operated businesses—and especially telecommunications businesses—is one of the best ways to: 1) develop grassroots expertise and leadership in telecommunications, 2) create new jobs on Indian reservations and in Native villages and communities, 3) stimulate the Native economy, and 4) potentially open up new opportunities for Native businesses to compete in regional, national, and international markets.[5]

Environmentally Sound Economic Development

In an area were expertise and capital are limited how can Native Americans advance a viable strategy for economic development?

Economic development in Native American communities, villages, and tribes is generally predicated on a requirement to protect the environment and honor the earth. Technology affords opportunities to conduct business without the destruction of resources. Computer networking is rapidly becoming an important tool of successful businesses in the major metropolitan areas and telework centers. This is likely to be true as well for Native owned and operated businesses, especially those located in remote areas. Illustrative applications include tracking private-sector business opportunities using computerized trading, sales, and marketing databases, exchanging market leads with other Native enterprises; identifying venture capital, banking, and government funding sources for minority enterprises; and marketing Native products and services over the rapidly growing electronic enterprise networks.

Effective use of computer networking by Native business people would require significant training on both the conceptual and technical levels. Providing affordable access to technology and resolving intellectual property issues (e.g., copyright and trademark protection) that concern electronic entrepreneurs would also need to be addressed.

Many other tribal businesses may want to use an information system or establish a local area network to support company operations. Commercial systems for small businesses without in-house technical expertise are increasingly available at declining costs. Tribal companies may also consider connecting to wide area net-works, such as the Internet, for electronic commerce or telemarketing. While this currently requires technical assistance, in the future it should be as easy as establishing and using a telephone connection—given a modern telecommunications infrastructure.

U.S. FEDERAL TRUST RESPONSIBILITY

One major problem concerning Native Americans is the issue of trust responsibility with the federal government. The essence of the federal trust responsibility is to ensure the survival of Indian communities. Under the trust responsibility, Indians possess rights as a group, in addition to rights as individuals. The unique status of Indian tribes is based on the historical relationship between tribes and the federal government.[6] The federal trust responsibility includes serving as trustee of tribal lands and natural and financial resources, and providing services necessary to the health and welfare of Indian tribes.[7]

A continuing challenge is updating the scope and definition of the trust responsibility to reflect modern life. In original treaties, for example, the federal government often promised to provide teachers, doctors, and annuities (in the form of food and supplies) to tribes in return for cession of tribal lands.[8]

If the trust responsibility is to have meaning, it must keep pace with changing social and economic realities. This adjustment has been made in areas such as health, education, and land and resource management as tribes and the relevant federal agencies have gained experience as partners in the government-to-government relationship.[9] Including telecommunications within the trust responsibility would seem a logical next step because ensuring adequate telecommunications services and infrastructure, is important to the well-being and survival of tribes. It should also be considered in the evaluation of Universal Access.

The governmental organization that has the responsibility of this trust agreement is the Bureau of Indian Affairs (BIA) under the United States Department of Interior. Some 56 million acres of tribal land is held in trust for the Indians by the BIA. This arrangement may have kept the reservations intact. But it has definitely helped keep the Indians in their place because they have been unable to use the one physical asset they have—their land—as collateral for loans to more efficiently exploit the land, or start businesses, or even improve their homes.[10]

Less tangible and much more important is a mental change. Like other prospering tribes around the country, the Oneida Nation is rebelling against decades of socialism imposed upon them by planners and administrators at Washington's BIA. They're taking their economic affairs into their own hands. As Deborah Doxtator, the Oneida Nation's thoughtful tribal chairwoman, puts it: "We are using the same concepts those Asian nations used to kick start their own economies."[11]

The Apache tribe is now running more of its own social program and schools without the BIA. The Apaches definitely aren't taking any chances with their hard earned money. Wells Fargo bank, not the federal government, manages their nest egg of about $8 million—smart thinking, considering the BIA's scandalous mismanagement of Indian funds over the years. What's going on at the reservations is not capitalism at its most individualistic. Most of the enterprises are owned by the tribal governments. The next step, say forward-thinking tribal leaders and people who have studied Indian economic development, is to get more private Indian - owned businesses started. But raising capital poses a vexing problem.[12]

One new direction being proposed has been brought about by the federal government's mishandling of more than $2.4 billion of tribal trust funds and millions, if not billions, more in Individual Indian Moneys (IIM) funds.

Paul Homan, a prominent bank regulator called in (by the president) to help clean up the BIA's trust fund mismanagement problem, has a plan to make more capital available to all the tribes. He proposes that Congress fund an Indian credit bank similar to the World Bank and other international aid banks that have played an important role in funding private enterprise when private banks were reluctant to make loans.[13]

Homan says it could be done with $500 million from funds already in semipublic banks. The American Indian Trust Development Bank would lend to Indian-owned banks, or directly to private projects on reservations. **"It could be the engine of economic growth on reservations for the next century,"** Homan avers. Previous trust fund and IIM funds audits uncovered a "serious breach of trust," according to Mr. Homan. Billions of dollars are missing or unaccounted for, and a completely detailed audit is impossible because of missing or lost records, according to the General Accounting Office.[14]

One concern presented to Mr. Homan was whether this was in fact termination of the government's trust responsibility. "It most certainly is not in my view. In fact there's been a steady erosion of the government's ability to fulfill its trust responsibilities. The number one problem is the persistent lack of funding in the BIA over the last 20 to 30 years, which has rendered their systems and their people essentially obsolete and incapable of running a modern trust system," Mr. Homan said.[15]

He holds out little hope, however, that his plan will be developed because of the cost. He said it would take between $80 and $100 million to implement the plan, which Congress would have to appropriate. The plan would take two years to implement, but the administration has not indicated it would support the funding at that level. Mr. Homan said the president's long term budget includes no more than $15 million. Secretary of Interior Bruce Babbitt is opposed to Mr. Homan's plan. Mr. Babbitt said the special trustee went considerably beyond his mandate and established an entirely new government agency, which takes most of the responsibilities from the BIA.[16]

Were do Native Americans go to find capital for economic development? If tribes cannot receive their trust money that is legally owed and the government refuses to change an out-dated system to fulfill its trust responsibility, then it is up to the Native Americans themselves to realize change. In this article I will use one particular example to show how tribes can not only break away from the socialism of the United States government but also capitalize on their exclusive rights as sovereign nations.

NATIVE SOVEREIGN BANK

The First Lenape Nation Bank was chartered in December of 1996 by the sovereign Delaware Indian tribe in Oklahoma. It is the first bank in the U.S. that can keep bank account activities a secret because it does not fall under U.S. federal regulations.

So what makes the First Lenape Nation Bank an offshore bank? The answer is tribal sovereignty. First Lenape is owned by the Delaware tribe of western Oklahoma, a sovereign Indian Nation whose independence from U.S. state and federal authority has been federally recognized since 1934. So in return for getting their land stolen, the Delaware's, who were originally from their namesake state and were exiled to Oklahoma, get to operate a bank that can guarantee Swiss-style banking secrecy to both tribal member and nonmembers. That means numbered accounts, full nondisclosure of account information, no compliance with snooping law enforcement, protection from civil court judgments, and no reporting of interest to the IRS or of cash deposits over $10,000 to the Treasury Department.[17]

The government's concerns are certainly worthy. Too bad they have little power to act on them. Broadly written tribal-sovereignty laws that mandate equal, government-to-government negotiations with tribes put Native Americans in the unique position of being the only Americans who can basically tell the government to go to hell. Sure, authorities can attempt to wield influence over tribal government or modify tribal law through congressional action, but given the sad history of relations between the government and Native Americans, bullying Indians just doesn't look good. The one piece of leverage the regulatory authorities do have is that First Lenape needs their blessing to establish relationships with other banks.[18]

Whether the Delaware's can really do this remains to be seen. Since there's no U.S. tribal law relating specifically to banking and no tribe has ever attempted to build a little Cayman Island in the middle of Indian country, this pugnacious bank is entering virgin territory.[19]

What does all this mean for a Native American economic development strategy? At first examination one might conclude that this is just another scheme praying on Native Americans and using their status as Sovereign Nations to commit crimes. When outside influences control the fate of Native Americans this will always be the case. This examples does show a real need and a possible solution to the failed U.S. Federal strategy. When tribes are not allocated moneys owed them, they are forced to make alternate strategies. There are tribes like the Oneida Nation that have a $100 million a year casino operation. They have proven that self-determination does work.

Figuring that the gambling windfall won't last forever, the Oneida nation has been diversifying its economy by moving into manufacturing and services. Two years ago the tribe paid about $40 million for a 49% stake in Airadigm Communications, a mobile telephone company serving Wisconsin and Iowa. Another $22 million bought a minority interest in Oneida nation Electronics, a joint venture with Plexus, a publicly traded circuit-board assembler. The Oneida's also own one-third of the state -charted Bay Bank, and are negotiationing to set up a medical products manufacturing company and a metals fabrication company. The ambitious goal is to have non-gambling enterprises bring in about $70 million a year in revenue by 2007.[20]

So far I have examined very specific areas of Native American's relationship to the United States government. I have proven that the trust responsibility is not being realized for the betterment of Native peoples. The only way for Native American's to break out of institutionalized welfare is to do it themselves. This is where the combination of cutting edge technology and the tribes ability to utilize their sovereign status to overcome 200 years of bureaucratic mishandling and 500 years of cultural erosion, sheds light on this dark future.

International telecommunications progressively opened world markets for financial institutions, but have also had a more immediate and darker effect on world banking, encouraging many banks to locate offices or branches "offshore" in countries where there are few or no regulations or taxes. Information technology also makes possible new types of crime that victimize banks and subjects them to possible data loss, system failure, and other vulnerabilities.[21]

Banks operate communications systems, telecommunications firms offer financial services. But the market encroachment is one-sided. Telecommunications companies are increasingly including financial services among information services they intend to offer, and are also creating subsidiaries for leasing, financing, and investing. Banks are more limited in the range of activities that they may conduct.

BANKS NETWORK CAPACITY

In most countries, banking and telecommunications have both been highly regulated, and institutions that engage in both have borne a double burden. Banking regulation controls the financial services that can be offered and the activities that banks may engage in. Communications regulation controls the technology by which services are delivered and, with respect to many local and long-distance network services, the rates that may be charged. Both affect the classes of customers to whom financial services are offered.

Financial institutions operate corporate communications networks and share with other financial institutions the ownership and management of value-added networks. They may also make it possible for their customers to access their networks and they may offer enhanced data communications services. To a limited extent, they are thus competing in the telecommunications services market.

Estimates are that the average use of private networks by financial institutions varies between 10 to 30 percent of capacity. This overcapacity came about because in the booming 1980's financial institutions overestimated their future traffic to allow for growth, and also regarded some overcapacity as insurance in case of circuit failures. Their gusty traffic also results in excess capacity, particularly during certain off-periods of the day. This raises the possibility of financial institutions reselling the excess capacity on their private networks.[22]

In the United States, for national banks and federally regulated banks, both banking law and communications law govern resale of telecommunications capacity. Under banking regulations, a bank may operate a network only for financial data. Under communications law, resale requires a "214 certificate" issued by the Feral Communications Commission (FCC) (under section 214 of the 1934 Communications Act) that would subject the bank to common carrier regulation.[23] Banks can make some excess capacity available to other institutions or customers for limited purposes but only if the excess is "genuine, not manufactured excess." They may not routinely resell capacity.[24]

In evaluating network capacity, and the resale of telecommunications capacity one question arises. After purchase of network capacity, what would stop a Native American telecommunication-financial institution from routinely reselling excess capacity?

Banks have traditionally served as intermediaries and escrow agents between lenders and borrowers by holding deposits and dispersing loans, or linking buyers and sellers and handling currency transactions for them. Now telecommunications companies are moving into this market. Although U.S. banks are prohibited from operating telecommunications systems except for financial services use, telecommunications companies are offering financial services and becoming competitors to banks.

A global marketplace for financial services has developed. It was made possible by international telecommunications networks and liberalization or deregulation of banking and financial markets. These financial institutions are currently re-assessing the comparative advantages of Private vs. Public communications networks in light of new telecommunications technologies and services. The results are often hybrid systems, with a mix of services, providers, and managers. U.S. banks increasingly see the need for close cooperation with telecommunications providers to support their overseas activities.

Now imagine Sovereign Telecommunications Networks with a Native Sovereign Bank as the main financial muscle. There is no specific U.S. federal regulation that prohibits the existence of Native American banks. If financing of such a project came into existence, why couldn't this same corporation become a common carrier, by-passing the Bank Holding Company Act and approval of the Federal Reserve Bank?

Another possibility for a Native Sovereign Bank would be to utilize The Edge Act of 1929. This act allows national banks to conduct foreign lending operations only through Federal or State chartered subsidiaries. These Edge Act corporations, unlike domestic banks, can own banks in foreign countries. Only very large banks tend to have Edge Act subsidiaries that can provide international services. This factor should not be overstated, however. While a bank must be fairly large to sustain overseas activities, it is not clear that greater size and diversity would guarantee successful international operations.

U.S. banks have also been hurt in recent years by the large trade deficit, the low savings rate, losses on developing countries, debt on commercial real estate, and a migration of retail deposits to non-bank competition such as mutual funds. The Federal Deposit Insurance Corporation Improvement Act of 1991 (Public law 102-242) may further inhibit international banking because it requires U.S. banks to increase capital reserves and foreign banks to undergo more stringent supervision.[25]

This may be the case for a regulated and evolving U.S. banking system. But again there are no specific federal laws that state a Native Sovereign Bank cannot use its network for both carrier and financial services. This bank would overcome overlapping and confused regulatory jurisdictions resulting from competition between banks and telecommunications companies.

International transmission lines are generally provided by the joint investment of telephone companies or PPTs in two or more countries using the facility, with switching remaining in national hands at either end of the transmission line.[26]

In some countries, electronic fund transfer (EFT), credit card authorization, and switching for automated teller machines (ATM) are considered telecommunications services, with varying degrees of regulation. Banks often operate cash netting services for multinational corporations. These services enable the corporations to make fund transfers and settlements among subsidiaries around the world, from a personal computer that ties into the banks' networks. Most such systems accommodate some message transmission in the from of instructions or explanations.

If payment systems are viewed as telecommunications networks rather than as banking networks, any third party can provide switches to route money transfers from one location to another across national boundaries, although ultimately, transfers must show up on the books of depository institutions. In the U.S. banks now have to compete with money market funds for deposits and non-bank institutions may process and switch monetary debits and credits. Regulators are increasingly less able to monitor, measure and perhaps, control money supply.

U.S. telecommunications and banking law have not been established for Native Americans. It is ironic that the oldest people of North America now look to the latest technology to preserve their way of life. The rise of a new world economy driven by Information Technology has just recently given Native Americans options in not only regional but also international trade. North American tribes proved that the gaming industry could provide self sufficiency. Now Natives look to the next economic phase of the 21st Century. So what are the fundamental questions we must ask ourselves to overcome an uncertain future?

Today, the number of Native owned and operated telecommunications companies is very small -a few telephone and cable companies and radio stations. Native entrepreneurs wishing to form telecommunication companies must overcome significant financial, technical and human resource barriers. Some Native communities may find that needed telecommunications are accessible and affordable from non-native companies. Many native communities may not have a market large enough to justify and sustain the formation of new telecommunications providers. Contiguous or adjacent Native communities could, in some cases, join forces to create a larger market.

This larger market could be capitalized with either federal trust funds, or more likely through a network of Tribal Governments, Multinational corporations, and institutions. One area this network could derive its economic power is through Native owned banks. There is a history of lack of financial institutions that are located on Native lands or that even serve Native interests. A pool of Native funding and private investors could create a legitimate, fully functional Native Sovereign Bank.

This bank would first have to be connected to a Native American network, serving the needs of it's members. The next stage of maturity would be to cater its services to the international markets. One which could conduct business on U.S. soil. Thus, guaranteeing the security and stability of the currency and the political system.

Since there are no test cases or even a conceptual model featuring a Native telecommunication / financial institution, the future of the Native American Global Telecommunications services industry is unclear. However, after viewing this report, I hope this paradigm will make the possibilities a little brighter. In order to have a sound environmental economic development strategy, issues of cost effectiveness and feasibility should be addressed by a consortia of Native American economic development experts.

BIBLIOGRAPHY

Darlin, Damon, "Rebellions on the reservation: one of the last bastions of socialism- the Bureau of Indian Affairs—is finally beginning to crumble." Forbes, May 19, 1997 v159 n10 p88 (7).

Eubanks, Walter W., "Banking reform and international banking," Congressional Research Service, February 20, 1992.

Greene, Majorie, "Public policy and international telecommunications technology in financial markets- an overview," OTA contractor report, February 1992.

Melmer, David, "Analysis: Reform of federally mismanaged tribal trust funds unlikely" Indian Country

Melanie Warner, "Who needs the Cayman Islands?" Fortune, June 23, 1997 v135n12 p38.

Morton v. Mancari, 417 U.S. 535 (1974). See generally Sharon O'Brien, American Indian Tribal Governments (Norman, OK: University of Oklahoma Press, 1989)

Office of Technical Assessment (OTA) report on Telecommunications Technology and Native Americans: opportunities and challenges 1995

Podgers, James, "Greetings from Hawaii," American Bar Association Journal, June 1997 p. 74-79

Pommersheim, Frank, "Tribal-State Relations: Hope for the Future," South Dakota Law Review, Vol. 36, 1991, pp. 239,245

Suagee, Dean B., "Self-determination for Indigenous Peoples at the Dawn of the Solar Age," University of Michigan Journal of Law, vol. 25, 1992, pp. 701-712

A few were reported during the summer of 1992 in the course of investigations of the activities of BCCI. The Daily Telegraph, August 3, 1991, p 2.

END NOTES

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[1] Native Americans are defined in this report to include American Indians, Alaska Natives (Indian, Aleut, and Eskimo), and Native Hawaiians who are descendants of indigenous peoples who lived in geographic areas now comprising the United States

[2] James Podgers, "Greetings from Hawaii," American Bar Association Journal, June 1997 p 74-79

[3] Ibid

[4] OTA report on Telecommunications Technology and Native Americans
opportunities and challenges 1995

[5] Ibid

[6] Morton v Mancari, 417 U S 535 (1974) See generally Sharon O'Brien, American Indian Tribal Governments (Norman, OK University of Oklahoma Press, 1989)

[7] Frank Pommersheim, "Tribal-State Relations Hope for the Future," South Dakota Law Review, Vol 36, 1991, pp 239,245

[8] Ibid

[9] See generally Dean B Suagee, "Self determination for Indigenous Peoples at the Dawn of the Solar Age," University of Michigan Journal of Law, vol 25, 1992, pp 701-712

[10] Damon Darlin, "Rebellions on the reservation one of the last bastions of socialism- the Bureau of Indian Affairs is finally beginning to crumble" Forbes, May 19, 1997 v159 n10 p88 (7)

[11] Ibid

[12] Ibid

[13] Ibid

[14] David Melmer, "Analysis Reform of federally mismanaged tribal trust funds unlikely" Indian Country Today, March 10, 1997 p31

[15] Ibid

[16] Ibid

[17] Melanie Warner, "Who needs the Cayman Islands?" Fortune, June 23, 1997 v135n12 p38

[18] Ibid

[19] Ibid

[20] Damon Darlin, "Rebellions on the reservation one of the last bastions of socialism- the Bureau of Indian Affairs is finally beginning to crumble" Forbes, May 19, 1997 v159 n10 p88 (7)

[21] A few were reported during the summer of 1992 in the course of investigations of the activities of BCCI The Daily Telegraph, August 3, 1991, p 2

[22] Majorie Greene, "Public policy and international telecommunications technology in financial markets- an overview," OTA contractor report, February 1992

[23] In December of 1991, the FCC proposed to permit resale between the U S and other countries with equivalent opportunities

[24] In 1982 Citicorp applied to the FCC for permission to provide a common-carrier service focusing on banking, financial, economic data The FCC refused on the ground that under the Bank Holding Company Act, the approval of the Feral Reserve Bank would be required for Citicorp to engage in common-carrier communications (Citibank does not resell capacity, an says that it now has not interest in being a common carrier)

[25] Walter W Eubanks, "Banking reform and international banking," Congressional Research Service, February 20, 1992

[26] The transoceanic cable systems have consortium ownership that traditionally reflected the degree of national use of the cable Satellite transmission facilities are collectively owned and operated by the world's governments through Intelsat with shares proportional to nationally use of the system

Global Personal Roaming —beyond regional system boundaries—

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Abstract—This paper discusses global personal mobility support among different cellular systems. There are three regional standards for MAP (Mobile Application Part) for existing second-generation digital cellular systems. These cellular systems lack interoperability among different standards. The proposed method with roaming gateway absorbs the incompatibilities among cellular standards and resolves the problem of inter-system operations. It will interconnect heterogeneous mobile networks and extend subscribers' personal mobility all over the world.

I. INTRODUCTION

World mobile communication systems are now in the process of evolving from second generation to third generation. In the second generation era, each region has its own standard system and regional radio interfaces are not compatible with each other, i.e., GSM (Global System for Mobile communications), PDC (Personal Digital Cellular), and IS-95 (Interim Standard 95). Each digital cellular system has a different standard for network protocol called MAP (Mobile Application Part) [1][2][3]. There exist three regional standards for MAP in North America, Europe and Japan. The method of mobility management and call control specified in each standard is different and not transparent.

Cellular networks provide terminal mobility for mobile users within regions of the same standard. The standards divide service coverage into three domains and restrict their terminal mobility within the countries that adopt the same cellular standard. However GSM removable smart card as subscriber identity module (SIM) and GSM MAP provides user international SIM card roaming over GSM networks.

The third generation mobile telecommunication system named IMT-2000 (International Mobile Telecommunications 2000) previously known as FPLMTS (Future Public Land Mobile Telecommunication Systems) is under development by both the ITU-T (International Telecommunication Union Telecommunication) and ITU-R (International Telecommunication Union Radiocommunication) [4]. The third generation system was initially expected to provide a global access capability with a unified single radio interface and an advanced backbone network. However, regions are evolving their mobile systems towards third generation based on their existing infrastructures. Therefore, it is not likely that there will be one unified mobile system even in the next generation, and global personal mobility beyond system boundaries is still a challenging target. In order to overcome this limited mobility within one system, a novel interworking technology is necessary.

In this paper both service concept and network architecture are discussed which enable global roaming between such different mobile systems. Our approach for global personal roaming adopts the concept of smart card for subscriber identity and roaming gateway for signaling conversion. This roaming gateway can provide a global personal roaming service that enables a smart card holder to use the same directory number during inter-system roaming in the different mobile telecommunication networks. Roaming gateway will be located at intermediate points of mobile telecommunication networks, where they will deal with the conversion of signaling protocol and user information.

We also report a prototype of a roaming gateway for a roaming service between GSM and PDC. This node with interworking function can absorb inter-system differences and provide interoperability between GSM and PDC mobile networks.

II. OVERVIEW OF REGIONAL STANDARDS

In this section we present an overview for regional cellular standards from a viewpoint of personal roaming.

A. *North American Cellular Standard*

IS-41 (Interim Standard 41) is the mobile network standard for cellular and Personal Communications Services (PCS) networks in North America. It supports cellular inter-system operations and automatic roaming among analog cellular or AMPS (Advanced Mobile Phone Service), digital cellular and PCS systems. These digital systems include IS-54 or IS-136 based TDMA (Time Division Multiple Access), and IS-95 based CDMA (Code Division Multiple Access).

Signaling specified in the IS-41 standard is based on the American National Standard Institute (ANSI) Signaling System number 7 (SS7), and X.25 protocol is specified as an alternative for SS7. Fig. 1 depicts an example of the configuration model of the IS-41 public land mobile network (PLMN) except Message Center and Short Message Entity. It also shows interface reference points of B, C, D, E, F, and H. The Home Location Register (HLR) is a data-base of subscriber information. The Visitor Location Register (VLR) is a data-base of roaming subscriber information. The Authentication Center (AC) is used to verify a mobile station's identity. Equipment Identity Register (EIR) is a data-base for the mobile equipment related data but F interface is not standardized in the revision C of IS-41. Majority of IS-41 networks use Signaling System No.7 to transfer the data and information of PLMN applications. SS7 network consists of signaling points (SPs) and communication links.

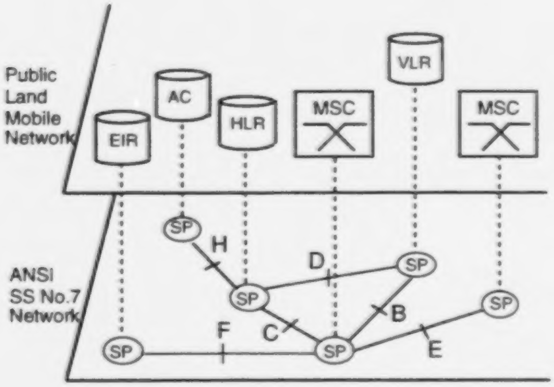

Fig. 1. Configuration of IS-41 PLMN.

B. GSM Standard

GSM is the TDMA-based digital cellular standard in Europe. A GSM MAP based network supports its key feature of international roaming. GSM supports SIM card roaming for GSM variants operating different radio frequencies. GSM MAP is based on ITU-T SS7 protocol used in many countries and the international SS7 network. Fig. 2 depicts the basic configuration of the GSM network except Interworking MSC (IWMSC).

C. PDC Standard

PDC is the TDMA-based standard in Japan. The Telecommunication Technology Committee (TTC) has standardized TTC MAP (PDC MAP) for PDC. PDC MAP is based on TTC SS7 used in domestic telecommunication networks in Japan. Fig. 3 depicts the network configuration and interface reference points in the PDC standard. VLR is not used in PDC networks. Instead of VLR, Gateway Location Register (GLR) is specified for inter-PLMN roaming users.

The number and ID will be stored in the PDC mobile station (MS). The Association of Radio Industries and Businesses (ARIB), formerly the Research and Development Center for Radio Systems (RCR) standardized the technical specification of the interface between Subscriber Information Module (SIM) and mobile equipment (ME). It was incorporated in the revision F of RCR STD-27 in February 1997.

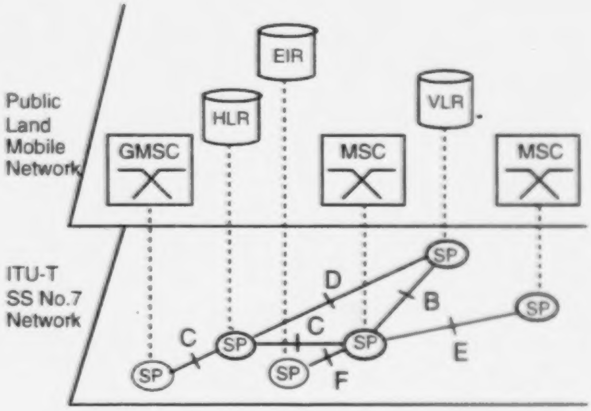

Fig. 2. Configuration of GSM PLMN.

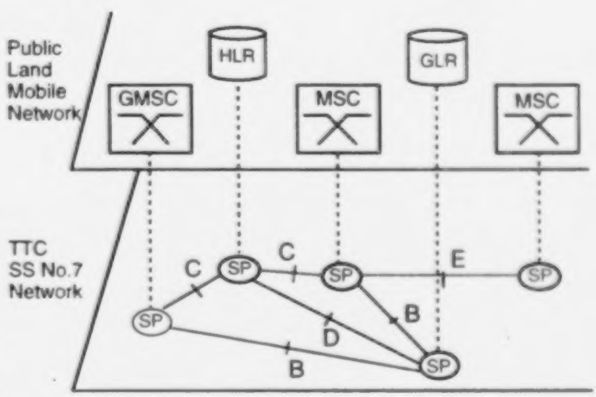

Fig. 3. Configuration of PDC PLMN.

III. COMPARISON OF SYSTEMS

A. Comparison of Identification and Networks

Table I compares the parameters of the identification numbers among three cellular standards. A user of an IS-41 cellular is identified by a unique Mobile Identification Number (MIN). It is a 34-bit number that represents a 10-digit directory telephone number assigned to MS. The directory number of the North American Numbering Plan (NAMP) is stored in the mobile terminal. As for a CDMA-based cellular, IS-95 revision A specifies that MS operating in the analog mode use MIN and operating in the CDMA mode use International Mobile Station Identity (IMSI)[21].

TABLE I
Comparison of identification parameters.

Number or ID	IS-41	GSM	PDC
user ID	MIN (IMSI)	IMSI	MSN
terminal ID	-	-	MSI
serial number	ESN	IMEI	MS Serial No.
telephone number	MDN	MSISDN	MSN
numbering for MS	NAMP	international	national
personalization	user entry	SIM	stored in MS (SIM option)

TABLE II
Comparison of inter-system signaling.

ID	IS-41	GSM	PDC
roaming number	TLDN	MSRN	RON
numbering for roaming number	NAMP	international	national
allocation of roaming number	per call basis	per call basis	location update basis
signaling	ANSI SS7 or X.25	ITU-T SS7	TTC SS7

GSM user is identified by GSM IMSI (International Mobile Subscriber Identity) in accordance with E.212 IMSI (International Mobile Station Identity). PDC user and terminal are identified by the pair MSN (Mobile Subscriber Number) and MSI (Mobile Station Identifier) in nationwide PDC networks

Table II summarizes the differences among specifications concerning roaming number and inter-system signaling. The mobile station roaming number defined in E.213 is a number allocated to a roamed MS to reroute calls to that station[18]. It would have a country code. PDC MAP specifies that RON (ROaming Number) is a number used within PDC PLMNs. Therefore, RON is unsuitable for direct routing of a call to the roaming MS [3].

The definition and allocation timing of roaming number assignment will impede interoperability of call routing with user roaming in different networks that do not conform to the standard of a user's home network.

TABLE III
Comparison of security parameters.

ID	IS-41	GSM	PDC
secret key	64-bit A-key	128-bit Ki	a pair of 64-bit keys
authentication key	64-bit SSD-A	128-bit Ki	a pair of 64-bit keys
random number for authentication	32-bit RAND	128-bit RAND	64-bit number
signed response for authentication	18-bit AUTHR	32-bit SRES	64-bit number
ciphering key	64-bit SSD-B (VPMASK, SMEKEY)	64-bit Kc	64-bit key

B. Comparison of Security Aspects

The definition of the secret key, random number, signed response and ciphering key differs in configurations and generation algorithms among the three systems (Table III). For IS-41, a calculation program for a security algorithm named Cellular Authentication and Voice Encryption (CAVE) is implemented in the MS. It provides security functions of MS authentication, Signaling Message Encryption, and Voice Privacy. The MS executes CAVE and generates Shared Secret Data (SSD-A and SSD-B) derived from a primary key called A-key (Authentication key) stored in the MS.

In GSM, in order to support the security features of authentication and ciphering, SIM provides the algorithms A3 (authentication algorithm) and A8 (cipher key generator) [15]. These algorithms produce the security vectors of signed response (SRES) for authentication and ciphering key (Kc) from the two input parameters of random number (RAND) and Ki[16]. The differences among security features of cellular systems cause severe problem for personal roaming.

C. *Comparison of Subscriber Identity Module*

In GSM, a subscriber's identity is stored in the Subscriber Identity Module (SIM). Security applications including related data and algorithms for authentication and ciphering are supported by SIM. Two physical types of SIM (smart card) are specified in GSM and PDC Standard[9][10]. These are the "ID-1 SIM" (credit card sized SIM) and the "Plug-in SIM." Physical characteristics, electronic signals and transmission protocols of both SIMs will be in accordance with the International Organization for Standardization (ISO) standards [11][12][13].

To extend the capability of GSM SIM and PDC SIM, these applications can be incorporated in a multi-application card. Mobile telecommunication services may be one of the applications of the smart card. An application consists of a set of security mechanisms, files, data and protocols. Mobile equipment is specified to be able to accept ID-1 cards in GSM. On the other hand ID-1 card support is an optional feature in PDC mobile equipment.

Fig. 4 illustrates a simple logical directory structure of the Master File (MF), Dedicated File (DF) and Elementary File (EF) on the GSM and PDC SIMs. Dedicated files of DF_{GSM} and DF_{PDC} contain the application for GSM and PDC [9][10]. All these files can coexist under a MF on a multi-application card.

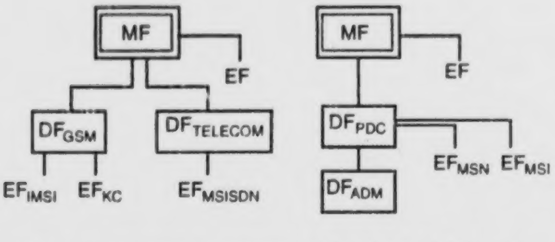

Fig. 4. Directory Structures of GSM and PDC SIMs.

IV. PERSONAL ID FOR GLOBAL ROAMING

We assume smart card roaming for global personal mobility over different systems.

A. *Smart Card for Global Roaming*

A mobile station must consist of a removable SIM and a mobile equipment (ME). The basic characteristics of the interface between SIM and ME must be compatible.

Fig. 5 shows the configuration of a multi-application card for global personal roaming. It is a triple-mode ID-1 card and contains applications supporting IS-41, GSM and PDC cellular standards. This multi-application card can contain plural independent cellular numbers assigned to a user.

It is desirable that this triple-mode card should contain three international mobile station identifications in accordance with ITU-T recommendation E.212. If a subscriber can be assigned the same number as an E.212 IMSI, the number identifies the subscriber and home network all over the cellular markets. As an alternative method a number as an IMSI to identify the HLR in the roaming gateway uniquely may be assigned. If IMSI or MSI is independently assigned in accordance with current regional standards, a user will be identified by two or three IDs. This case does not impact the existing cellular infrastructures, but all identification numbers must be prepared in the SIM personalization process. Thus, we recommend that one unique ID number assignment will be the best solution in the future.

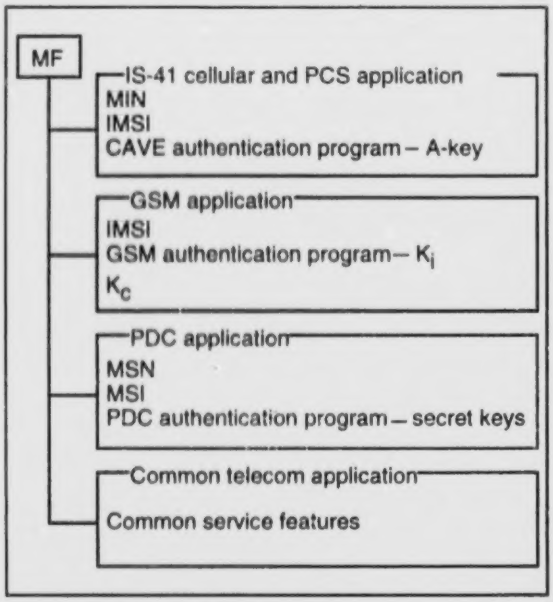
MF
IS-41 cellular and PCS application
MIN
IMSI
CAVE authentication program – A-key
GSM application
IMSI
GSM authentication program – K_i
K_c
PDC application
MSN
MSI
PDC authentication program – secret keys
Common telecom application
Common service features

Fig. 5. Multi-application smart card for three cellular systems.

B. *Addressing Support*

In GSM, VLR must derive the HLR address from the IMSI from a mobile station in its location updating procedure [2]. The result of a global title translation on the Signaling Connection Control Part (SCCP) will be a format of an SPC or an E.214 Mobile Global Title (MGT) [19]. An MGT number can be also translated into an SPC as well as an E.164 number. Both E.164 number and SPC (Signaling Point Code) are used as a SCCP addressing for destination in the existing SS7 networks.

In IS-41, revision C describes MIN-based inter-system operations but has not yet included IMSI-based operation, although IS-95 has adopted IMSI as an identity number in the digital mode.

Mobile telecommunication systems will introduce the features of IMSI introduce into their standards as GSM does. The requirements of IMSI may modify the standards associated with inter-network operation (MAP), Um interface between base station and mobile station, and A-interface between MSC (Mobile Switching Center) and base station. In order to provide global personal mobility for the user with an IMSI number, support of transparency and translation of an E.212 number will be necessary throughout digital cellular networks.

V. INTERWORKING FUNCTION AMONG HETEROGENEOUS NETWORKS

We describe in this section, interworking functionality for global personal mobility support and service portability.

A. *Personal Mobility Support*

Mobility support between cellular systems has been discussed [5][6][7][8]. Fig. 6 depicts the arrangement and configuration of a roaming gateway that provides interoperability and inter-system roaming service among IS-41, GSM and PDC cellular systems. This roaming gateway consists of location registers and an optional MSC. Principal functions for personal mobility and call establishment in the node are as follows:

1) Multiple signaling interfaces for plural MAP standards—roaming gateway should be equipped with interfaces of three standards of SS7. It may have an X.25 interface instead of ANSI SS7 for IS-41.
2) Location registers and D interfaces—Three HLRs in the roaming gateway permanently store subscriber information for global personal roaming services. The interface between HLR and VLR is defined as a D interface. This interface is used to exchange signaling information related to the location of the subscriber and to the management of the subscriber [14]. D interfaces for inter-systems between HLR and VLR will transform MAP messages and its parameters.

Mapping of number and identification—roaming gateway will support the function of mapping the user's mobile telephone number and IDs in the systems because user ID definitions in the standards are different. Home Location Registers in the roaming gateway will store the relations of user's number and IDs in its database. For the purpose of a subscriber's single personal identification, the set of IS-41 MIN, GSM IMSI and PDC MSN for a subscriber should be bound logically in the data-bases of roaming gateway.

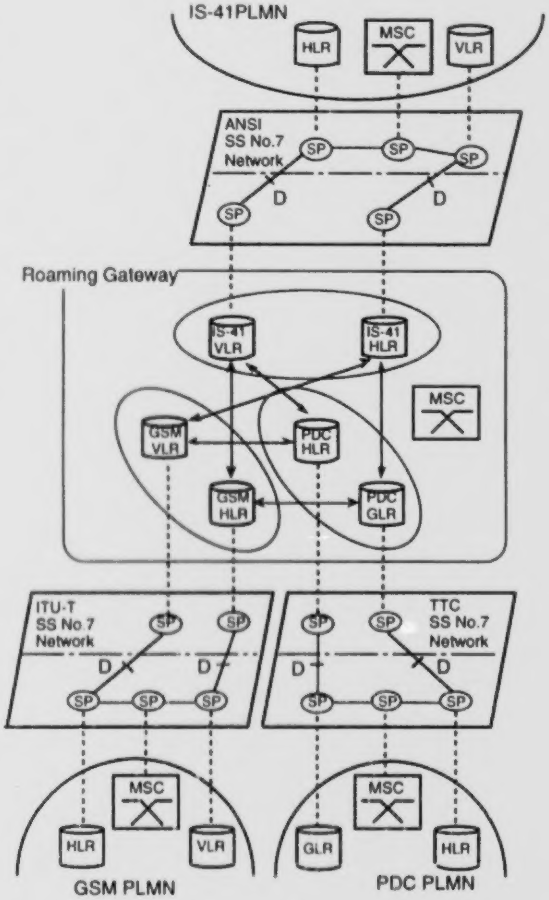

Fig. 6. Roaming gateway among three regional cellular standard systems.

1) Routing number management—The Roaming gateway supports the functions of routing number allocation and routing information retrieval at the interrogation of routing information because routing number or roaming number definitions in the standards are different. When an incoming call to an inter-system roaming user occurs, roaming gateway provides an inter-system routing number between home and visited PLMNs. Some systems do not support international routing. In this case the function of translating routing numbers is required for roaming gateway.
2) Authentication center—The roaming gateway stores and generates the data related to authentication and ciphering in the functional entity of an authentication center. It manages GSM Ki, IS-41 A-key, and PDC secret keys. Also, it has the authentication and ciphering programs of GSM A3/A8, IS-41 CAVE, and PDC algorithms.
3) Interconnection of circuits—The Mobile Services Switching Center (MSC) in the roaming gateway does not constitute the interface for the radio system, but the interfaces for transit exchange among PLMN, ISDN, and the public switched telephone network (PSTN). A switching system will be necessary optionally, and it will provide call routing to the roamer if SS7 ISDN User Part or Telephone User Part messages or parameters need modification. For example, it will need a switching center if a called party number parameter of an Initial Address Message (IAM) is not appropriate to reroute a call over international public switched telephone networks.

B. *Service Portability*

Mobile service definitions are different and incompatible among cellular standards. When the roaming gateway receives information about a subscriber's service from an HLR in a home network, it will translate and transfer it to the VLR (GLR in PDC) in the visited PLMN. The roaming gateway provides inter-system operations to transfer the subscriber's service information via D interfaces from the home network to roaming gateway, and from roaming gateway to visited network. If the roaming gateway is expected to invoke a service, it will execute an appropriate kind of service logic as a substitute for HLR or VLR.

Examples of features of service portability over inter-system networks are as follows:

- Sharing of provision status of services
- Sharing of registration status of services
- Sharing of registration information for supplementary services
- Automatic call barring

VI. PROTOTYPE DESIGN AND EVALUATION

In this section, we present the system configuration and technical features of the roaming gateway for interoperability between GSM and PDC. This roaming gateway is designed to provide a GSM and PDC roaming service. We study the case of interoperability and inter-system. In this case, roaming gateway consists of a simple subset of functional entities for global personal roaming. The device for the user's personal identification is a dual-mode application smart card for GSM and PDC.

We designed the configuration of a roaming gateway prototype and network service logic for inter-system operations in detail [20]. This includes authentication, location registration, location cancellation, routing information retrieval for roaming incoming calls, etc.

A fault-tolerant computer is used as a platform to develop and execute the prototype software. We have evaluated the designed protocols and service logic on the prototype in test environments connected to network simulators. We have made experiments on the prototype and examined service operation combined interworking with GSM and PDC network simulators.

The feasibility of interworking technology has been confirmed through the evaluation of the roaming gateway prototype.

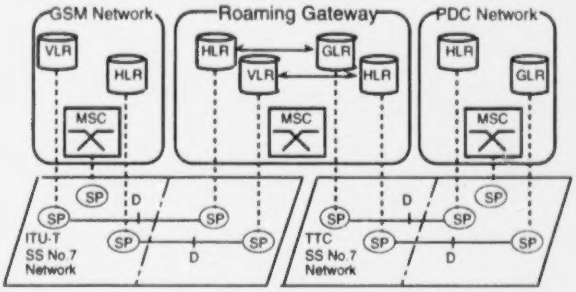

Fig. 7. Roaming gateway between GSM and PDC.

VII. CONCLUSION

This paper provides the concept of global personal roaming, and proposes the combination roaming gateway and smart card roaming. We designed roaming gateway to collaborate with second generation mobile telecommunication systems, and confirmed the feasibility of inter-system mobility support and service portability through this development of the roaming gateway.

The approach using roaming gateway is available for realization of a global personal roaming service among second generation systems. The roaming gateway adopts network interfaces of regional standards in order not to impact the network standards and infrastructures of many existing cellular systems. Even third generation systems will need this inter-system roaming operation. The roaming gateway technology will be able to link heterogeneous mobile networks, and to make them into a logical single plane network.

Third generation system will be an evolution of second generation networks, and maintain backward-compatibility considering the growing second generation markets. If the three current regional standards divide third generation standard systems, it will cause differences among third generation systems and the feature of inter-system operability would be mandatory.

The proposed interworking technique will also be applicable to the global personal roaming service over third generation mobile networks as long as the next network architecture and protocol are based on the current ones.

ACKNOWLEDGMENT

We would like to express gratitude to Dr. H. Murakami of KDD R&D Labs for his encouragement in this work.

ABBREVIATIONS

A3	Authentication algorithm A3
A8	Ciphering key generating algorithm A8
AC	Authentication Center
ANSI	American National Standards Institute
AuC	Authentication Center
AUTHR	AuthenticationResponse
CAVE	Cellular Authentication and Voice Encryption
CDMA	Code Division Multiple Access
DF	Dedicated File
EIR	Equipment Identity Register
ESN	Electronic Serial Number
FPLMTS	Future Public Land Mobile Telecommunication Systems
GLR	Gateway Location Register
GMSC	Gateway Mobile-services Switching Center
GSM	Global System for Mobile communications
IAM	Initial Address Message
IMEI	International Mobile station Equipment Identity
IMSI	International Mobile Subscriber Identity
IMSI	International Mobile Station Identity
IMT-2000	International Mobile Telecommunications-2000
IS	Interim Standard
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part (SS No.7)
ISO	International Organization for Standardization
ITU	International Telecommunication Union
IWMSC	InterWorking MSC
Kc	Ciphering key
Ki	Individual subscriber authentication key
MAP	Mobile Application Part
MDN	Mobile Directory Number
MIN	Mobile Identification Number
ME	Mobile Equipment
MF	Master File
MS	Mobile Station
MSC	Mobile Switching Center
MSI	Mobile Station Identifier
MSISDN	Mobile Station International ISDN Number
MSKY	Mobile Station authentication KeY
MSN	Mobile Subscriber Number
MSRN	Mobile Station Roaming Number
NAMP	North American Numbering Plan
PCS	Personal Communications Services
PDC	Personal Digital Cellular
PLMN	Public Land Mobile Network
PSTN	Public Switched Telephone Network
RAND	RANDom number (used for authentication)
RAND	RandomVariable
RANDU	RandomVariableUniqueChallenge (24-bit RANDU)
RON	ROaming Number
SCCP	Signaling Connection Control Part
SBKY	mobile SuBscriber authentication KeY
SIM	Subscriber Identity Module
SMEKEY	SignalingMessageEncryptionKey
SP	Signaling Point
SPC	Signaling Point Code
SRES	Signed RESponse (authentication)
SS7	Signaling System No. 7
SSD	SharedSecretData
TDMA	Time Division Multiple Access
TLDN	Temporary Local Directory Number
TTC	Telecommunication Technology Committee
VPMASK	VoicePrivacyMask

REFERENCES

[1] TIA/EIA, "Cellular Radiotelecommunications Intersystem Operations: Automatic Roaming Information Flows," *TIA/EIA IS-41.3 Rev. C*, Feb. 1996.

[2] European Telecommunications Standards Institute, "Digital cellular telecommunications system (Phase 2+); Mobile Application Part (MAP) specification," *ETSI GSM 09.02*, Aug. 1996.

[3] Telecommunication Technology Committee, "Mobile Application Part (MAP) Signalling System of Digital Mobile Communications Network Inter-node Interface (DMNI) for PDC," *TTC Standard JJ-70.10 Ver. 1*, Nov. 1993.

[4] ITU-R, "Future Public Land Mobile Telecommunication Systems (FPLMTS)," *Recommendation ITU-R M.687-2 1990-1992-1997*, 1997.

[5] Y. Nodera et al., "Interworking between GSM and PDC through IC Cards," *Proc. ICC'95*, Seattle, pp.761-765, June 1995.

[6] A. Yamaguchi et al., "Interoperability of PDC with GSM," *Proc. ICUPC '95*, Tokyo, pp.452-456, Nov. 1995.

[7] J. Lanto, "Towards a global cellular service," *Proc. ICUPC '95*, Tokyo, pp.457-461, Nov. 1995.

[8] Y. Uchiyama et al., "Network Functions and Signalling for Personal Roaming between Digital Cellular Standards," *Proc. ICUPC '95*, Tokyo, pp.447-451, Nov. 1995

[9] Association of Radio Industries and Businesses (ARIB), "Personal Digital Cellular Telecommunication System," *ARIB Standard RCR STD-27 Rev. F*, Feb. 1997.

[10] European Telecommunications Standards Institute, "European digital cellular telecommunications system (Phase2); Specification of the Subscriber Identity Module-Mobile Equipment (SIM-ME) interface," *ETSI GSM 11.11*, Nov. 1994.

[11] ISO, "Identification cards—Integrated circuit(s) cards with contacts—Part 1: Physical characteristics," *ISO 7816-1*, July 1987.

[12] ISO, "Identification cards—Integrated circuit(s) cards with contacts—Part2: Dimensions and location of the contacts," *ISO 7816-2*, May 1988.

[13] ISO/IEC, "Identification cards—Integrated circuit(s) cards with contacts—Part 3: Electronic signals and transmission protocols," *ISO/IEC 7816-3*, Sept. 1989.

[14] CCITT, "General aspects of Public Land Mobile Networks," *CCITT Recommendation Q.1001*, Nov. 1988.

[15] European Telecommunications Standards Institute, "European digital cellular telecommunications system (Phase2); Subscriber Identity Module (SIM) Functional characteristics," *ETSI GSM 02.17*, Sept. 1994.

[16] European Telecommunications Standards Institute, "European digital cellular telecommunications system (Phase2); Security related network functions," *ETSI GSM 03.20*, Sept. 1994.

[17] CCITT, "Identification plan for land mobile stations," *CCITT Recommendation E.212*, 1988.

[18] CCITT, "Telephone and ISDN numbering plan for land mobile stations in public land mobile networks (PLMN)," *CCITT Recommendation E.213*, 1988.

[19] CCITT, "Structure of the land mobile global title for signalling connection control part (SCCP)," *CCITT Recommendation E.214*, 1988.

[20] A. Yamaguchi et. al., "Inter-system mobility and service management in GSM/PDC roaming," *Proc. IEEE GLOBECOM '97*, pp. 694-698, Nov. 1997.

[21] TIA/EIA, "Mobile Station-Base Station Compatibility Standard for Dual-Mode Wideband Spread Spectrum Cellular System," *TIA/EIA IS-95 Rev. A*, May 1995.

Seamless Roaming between IS41-based CDMA Cellular Network and GSM-based Iridium Network

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1. ABSTRACT

The emerging GMPCS (Global Mobile Personal Communications by Satellite) service is widely believed to be a cost-effective way of providing global mobile communication service due to its global service coverage and internationally standardized subscriber identity and air interface. GMPCS, however, has two inherent drawbacks: limited satellite link capacity and "no service" spots such as in-building and underground areas. Therefore, GMPCS carriers are seriously considering the implementation of roaming with terrestrial cellular networks to secure competitive service quality and to increase financial opportunity to participate in a much larger cellular market. In this paper, we review technical issues related to roaming between mobile satellite and terrestrial cellular networks and then propose the implementation of roaming between IS41 cellular network and Iridium GMPCS network. Since Iridium protocol fully complies with GSM standard, the proposed roaming scheme can be applied to an international roaming between IS41 and GSM cellular networks.

2. INTRODUCTION

The arrival of global mobile telecommunication era is expected to be much accelerated by the launch of satellite mobile communication service such as Iridium, Globalstar, Odissay, and TeleDesic. In these emerging new mobile communication services which are usually referred to as GMPCS, tens of satellites circulate in the earth orbit and serve as base stations. Therefore, cost-effective global mobile communications service becomes possible not just in overseas countries but also in remote areas such as the Mount Everest, Amazon jungle, African safari, and Pacific Ocean. GMPCS network, however, has its own drawbacks inherent in its satellite communication technology: (1) limited communication capacity between satellite and mobile handset and (2) service unavailability at underground and in-building areas where satellite signal is hard to penetrate. In order to solve these problems, GMPCS carriers are seriously considering the roaming service with terrestrial cellular networks, especially with GSM and IS41 networks because they are the two major standards in the present cellular markets.

In this paper, we propose an implementation of a roaming service between Iridium network and IS41/IS95 based cellular network. We do not discuss Iridium-GSM roaming because both networks are based on identical GSM technology and thus the roaming is quite straightforward. IS-41 standard is, on the contrary, different from GSM standard in many aspects that a roaming between these two *heterogeneous* networks has many issues to be resolved.

This paper is organized as follows. In section 3, we first address major technical issues related to roaming between Iridium and IS41 networks, which includes subscriber identification, protocol conversion, call delivery, and authentication. We then introduce and describe the functionality of Interworking Node. In section 4, network configuration, roaming scenario, and call procedures is proposed as well. Finally the conclusion is given in section 5.

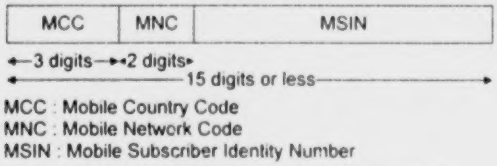
3. MAJOR ISSUES RELATED TO ROAMING SERVICE

A *heterogeneous* roaming is defined as a roaming between networks that have different network protocols and in many cases non-compatible air interfaces as well. In this section, we address issues in heterogeneous roaming: uniqueness of subscriber identity, protocol and signaling conversion, reciprocal authentication, and support of multiple air interfaces by handset. Based on the solutions discussed in this section, we will propose an implementation of roaming service between Iridium and IS41 networks in the following section.

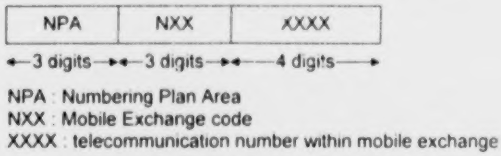
3.1 UNIQUENESS OF SUBSCRIBER IDENTITY

Various network entities require a means of uniquely identifying each subscriber. Therefore, the first necessary condition for a roaming is to guarantee the uniqueness of a roamer's identity at all visiting networks. The representation of subscriber identity is usually different from one network to another. Figure 1 illustrates two types of subscriber identity formats, IMSI (International Mobile Subscriber Identity) and MIN (Mobile Identity Number), that are defined in GSM and IS41 standards, respectively. MIN was designed without taking consideration into roaming with other networks and thus has two problems. The first one is that it has no MCC (Mobile Country Code) field. Therefore, global uniqueness of subscriber identity is not always guaranteed. For example, a subscriber in Asia may have the same identity as another subscriber in North America. The another problem is that its length is limited to 10-digits. Therefore, there is no simple way to represent GSM roamer's 15-digit IMSI in 10-digit MIN format.

The obvious solution to this problem is to introduce the IMSI structure into IS41 network. However, considering the amount of work required to modify IS41 network entities, *interim* approach of assigning IMSI (or MIN) to each IS41 (or GSM) roamer whenever IS41 (or GSM) subscriber roams in GSM (or IS41) network would be a more feasible solution for the time being. The subscriber's own IMSI (or MIN) then identifies his or her GSM (or IS41) identity at home network and MIN (or IMSI) does at the visiting network. The interim solution, however, has some disadvantages: (1) two subscriber identities for a single subscriber results in an inefficient usage of number, (2) assignment of IMSI and MIN pair should be coordinated to guarantee its uniqueness, (3) subscriber identity should be translated from IMSI to MIN and vice versa at the Interworking Node.


MCC
MNC
MSIN
3 digits
2 digits
15 digits or less
MCC : Mobile Country Code
MNC : Mobile Network Code
MSIN : Mobile Subscriber Identity Number

(a) IMSI(International Mobile Subscriber Identity)


NPA
NXX
XXXX
3 digits
3 digits
4 digits
NPA : Numbering Plan Area
NXX : Mobile Exchange code
XXXX : telecommunication number within mobile exchange

(b) MIN(Mobile Identity Number)

Figure 1. Subscriber Identifier Structure

3.2 MAP PROTOCOL CONVERSION AND SIGNALING NETWORK

Mobility management, call delivery, and other activities in mobile network are accomplished by exchanging a sequence of messages between network entities over signaling channels[1][2]. When a large number of networks are interconnected for global roaming, it is cost-effective to lease well *established* existing signaling network from the signaling hub network operators such as UWCN (Universal Wireless Communication Network) or GTE rather than constructing a *private* signaling network of its own. For a correct routing of these messages between network entities of both home and visiting networks, the MGT(Mobile Global Title) can be used. The MGT is retrieved from the subscriber's IMSI[3].

Similar to the subscriber identifier described in subsection 2.1, MAP(Mobile Application Part) protocols are greatly different from one network to another. Therefore, the message from one network should be appropriately converted before being forwarded to the other network. The usual way to perform message conversion is to use an Interworking Node between home and visiting networks as shown in Figure 2.

3.3 CALL DELIVERY

An incoming call is terminated as the following steps. First, the network locates and acquires "*routing number*" from the *serving* MSC/VLR with a help from HLR. It then establishes call path from *originating* MSC to the serving MSC/VLR. The structure of routing number is also different from one network to another. Routing number used in GSM network is MSRN(Mobile Station Roaming Number) which is a part of E164. And the most commonly used routing number in IS41 network is the Temporary Local Directory Number (TLDN). Both the MSRN defined in GSM and TLDN defined in IS41 Rev. C support the call delivery between overseas networks over PSTN but IS41 Rev. A and Rev. B, however, do not. Therefore, roaming between GSM and IS41 networks with Rev A. or Rev. B requires a conversion between 15-digit MSRN and 10-digit TLDN by the Interworking Node. Upon receiving translated TLDN from the Interworking Node, IS41 MSC "*retrieves*" international routing number and then terminates the call over PSTN. For that, TLDN prefix assignment should be coordinated between service operators.

3.4 AUTHENTIFICATION

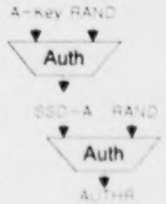
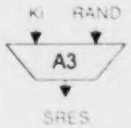
Authentication provides a secure means of preventing illegal access to the mobile network. As fraud becomes prevalent and causes a severe damage to the cellular operator's revenue, the authentication increases its importance in the cellular market. The authentication is generally performed in two steps. First both mobile station and Authentication Center (AC) execute an "identical" authentication algorithm using "identical" input parameters: (1) the secret authentication key which is unique to,each subscriber and (2) the non-predictable random number. Second, the result computed by the AC is compared with the result sent by the mobile station. If these two values are the same, the subscriber is granted to access the network[4].

As summarized in Table 2.1, the authentication in GSM and IS41 CDMA networks are basically the same but are quite different in procedures, messages, and input parameters. Making use of *Unique Challenge Procedure* defined in IS-95 standard and implementing additional MAP message within IS41 network, we can resolve differences in the procedures and messages[5]. The difference in parameter sizes, however, requires a modification of IS-95 air interface specification, which implies the recall of existing customer's handset. Therefore, a feasible way of authenticating roamer would be to assign *two* authentication keys to each roamer: a "*home authentication key*" and a "*roaming authentication key*." If a subscriber is roaming in other network, the Interworking Node authenticates the roamer using the roaming authentication key. Otherwise, home AC authenticates subscriber using home authentication key.

3.5 MOBILE STATION

All kinds of communication service in mobile networks require a data exchange between mobile handset and base station. Therefore, a roamer's handset should support air interfaces of both home and visiting networks. In case of roaming between geographically "overlapped" networks as in the case of Iridium and CDMA networks, the unique solution for roaming is to carry a dual mode/dual band handset because the handset automatically decides its operation mode based on the received air signals. If the detected Iridium signal is strong enough, the handset operates in Iridium mode. Otherwise it operates in CDMA mode. When both signals are strong, the handset's operation usually depends on pre-programmed service mode priority. If the SIM card is available, SIM (Subscriber Identity Module) card based "*plastic roaming*" becomes an efficient alternative to carrying a dual mode handset[6].

[Table 1] The Comparison of Authentication

	IS-41	GSM
parameter size	A-Key : 64 bits SSD : 64 bits RAND : 32 bits AUTHR : 18 bits	Ki : depends on service provider RAND : 128 bits SRES : 32 bits
computation system	AC or VLR	AC
computation time point	***Same*** as authentication process time point	***Different*** from authentication process time point
initiating part	MS	VLR
comparison system	AC or VLR	VLR
computation process		

4. ROAMING SCENARIO

In this section, we describe the network configuration and call procedures for reciprocal roaming between IS-41 and Iridium networks. This scenario assumes that the IS-41 network can process IMSI. If the IMSI can not be supported, The method using two-identifier described in the previous section, can be applied without any change to this scenario.

4.1 NETWORK CONFIGURATION

The overall network configuration for roaming is illustrated in Figure 2. The Interworking Node performs all kinds of interworking functions mentioned in the previous section and a call is terminated via PSTN by making use of the routing number acquired from serving VLR through the Interworking Node. The advantage of PSTN as a means of call delivery in comparison with *private* interconnection lies in PSTN's ubiquitousness.

4.2 INTERWORKING NODE

This section classifies and describes the functions performed by the Interworking Node. For the simplicity of presentation, we denote an IS41 subscriber who is roaming in the Iridium network as *outbound roamer* and an Iridium subscriber roaming in the IS41 network as *inbound roamer*.

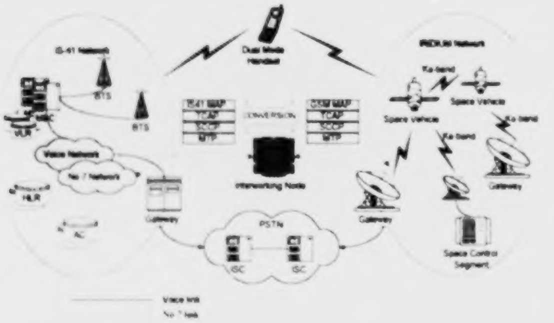


Figure 2. Network Configuration for roaming service

A. Protocol Conversion

MAP messages that are exchanged between home and the visiting networks should be converted at the Interworking Node as mentioned in the previous section 3.2. The conversion of "MAP_UPDATE_LOCATION" message to "Registration Notification" shown in Figure 3 is an example of MAP translation performed by the Interworking Node.

B. Virtual HLR and VLR functionality

When an IS41 subscriber roams in an overseas Iridium network, his dual-mode handset communicates with Iridium satellite and initiates a registration procedure as shown in Figure 3. Once his home HLR is informed of subscriber's roaming in Iridium network, the Interworking Node begins to operate as a VLR from point of view of IS41 network entities and as an HLR from point of view of Iridium network until the roamer returns back to his home IS41 network. Consequently, the Interworking Node is required to acknowledge all "location update request" from Iridium VLRs and to validate all calls originated by the roamer. As a serving VLR in the light of IS41 network, the Interworking Node is responsible for providing the routing number at the request from IS41 network so that calls are terminated on the roamer. For an inbound roamer visiting IS41 network, the Interworking Node similarly operates as a virtual VLR in the light of Iridium network and as a HLR in the light of IS41 network.

C. Virtual Authentication Center functionality for roamer

As mentioned in section 2.4, the Interworking Node authenticates the roamer while he is roaming in visiting networks by making use of *roaming authentication keys* and other relevant parameters obtained from the subscriber's home network. Authentication procedures for outbound and inbound roamers are illustrated in Figure 3 and 5, respectively.

D. Routing Number Translation for IS-41 Rev. A or B Networks

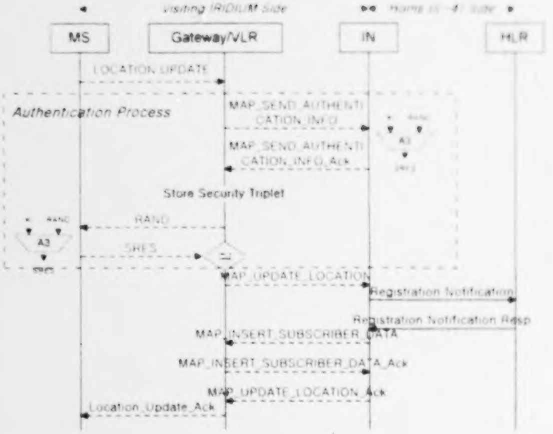
Unless IS41 network applies Rev. C or higher revision of IS41, the Interworking Node is required to convert routing number between 10-digit TLDN and 15-digit MSRN as mentioned in section 2.3. Since there is no international standard regarding the conversion between MSRN and TLDN, the conversion mechanism depends on an agreement between IS-41 and Iridium service providers.

4.3 CALL PROCEDURE

In the previous section, we described the network configuration and the role of the Interworking Node. In this section, we present the registration and termination procedures for *outbound* and *inbound* roaming.

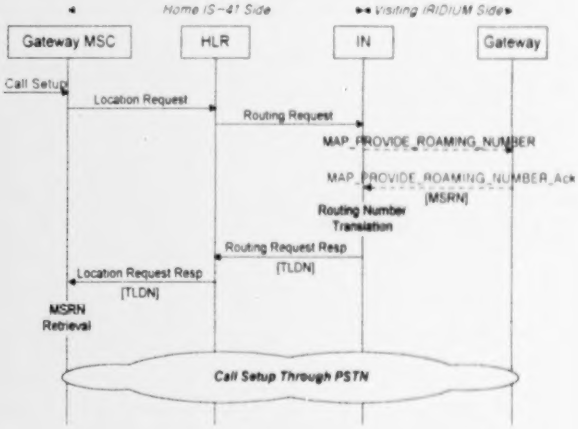
4.3.1 OUTBOUND ROAMING FROM IS41 TO IRIDIUM NETWORK

International roaming through Iridium network is an example of outbound roaming. As roamer leaves his home network and travels overseas countries, Iridium satellites circulating in the earth orbit begin to keep track of the roamer's whereabouts by sending "location update messages" to the Interworking Node as shown in Figure 3. Once the Interworking Node informs IS41 HLR of the subscriber's roaming in Iridium network, all subsequent location update messages from Iridium VLRs are not forwarded to home HLR due to the nature of virtual HLR functionality of the Interworking Node. When roamer returns back to IS41 network, serving VLR is changed from the Interworking Node to a newly created VLR. As a virtual AC for roamer, the Interworking Node performs "*authentication process*" upon request by IRIDIUM network as shown in Figure 3. Therefore, there is no need to transmit the authentication message to the home AC.
All calls destined to the roamer are first routed to IS41 home network. They are then rerouted over PSTN from "Home Gateway" to a serving Iridium Gateway. This call delivery makes use of the routing number acquired from the serving Gateway through the Interworking Node. Figure 4 illustrates this termination procedure and the MSRN-to-TLDN conversion at the Interworking Node. When a roamer places a call, the Iridium Gateway authorizes the roamer and then setup the requested call.


Visiting IRIDIUM Side
Home IS-41 Side
MS
Gateway/VLR
IN
HLR
LOCATION UPDATE
Authentication Process
MAP_SEND_AUTHENTICATION_INFO
RAND
A3
SRES
MAP_SEND_AUTHENTICATION_INFO_Ack
Store Security Triplet
RAND
A3
SRES
=
MAP_UPDATE_LOCATION
Registration Notification
Registration Notification Resp
MAP_INSERT_SUBSCRIBER_DATA
MAP_INSERT_SUBSCRIBER_DATA_Ack
MAP_UPDATE_LOCATION_Ack
Location_Update_Ack

IN : Interworking Node

Figure 3. Registration procedure of the IS-41 subscriber roaming in Iridium network


Home IS-41 Side
Visiting IRIDIUM Side
Gateway MSC
HLR
IN
Gateway
Call Setup
Location Request
Routing Request
MAP_PROVIDE_ROAMING_NUMBER
MAP_PROVIDE_ROAMING_NUMBER_Ack
[MSRN]
Routing Number Translation
Routing Request Resp
[TLDN]
Location Request Resp
[TLDN]
MSRN Retrieval
Call Setup Through PSTN

▨ : Processed only if IS41A or B

Figure 4. Termination procedure of the IS-41 subscriber roaming in Iridium network

4.3.2 INBOUND ROAMING FROM IRIDIUM TO IS41

Inbound roaming occurs, for example, when an Iridium subscriber enters into underground areas where Iridium signal is not available. The registration procedure for inbound roaming is similar to that of outbound roaming and it is shown in Figure 5. The IS41 VLR which first notices the existence of an Iridium roamer initiates the registration procedure. Once this registration procedure is complete, the Interworking Node operates as virtual HLR in the light of IS41 network and VLR in the light of Iridium network. The authentication of the roamer, however, may be slightly different from that of the outbound roamer because there are two types of authentication in IS-95 based CDMA network: "non sharing" and "sharing." If IS41 operator prefers to use its own authentication algorithm rather than Iridium's CAVE algorithm, non-sharing type of authentication should be used. Otherwise, either type of authentication can be used. Figure 6 shows that call termination procedure of inbound roaming is similar to that of outbound roaming. If the IS-41 network uses Rev. A or B, 10-digit TLDN from serving VLR should be converted into 15-digit MSRN and then transmitted to originating MSC in Iridium network.

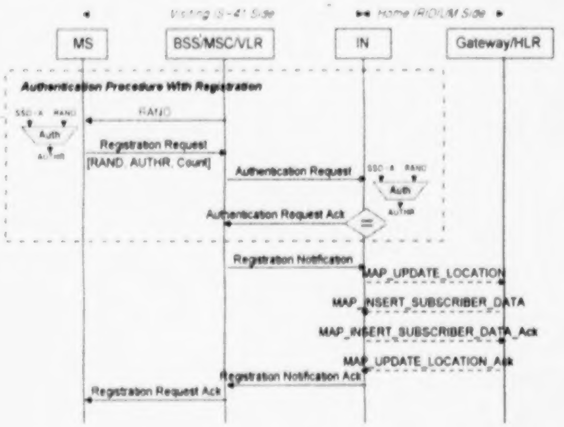
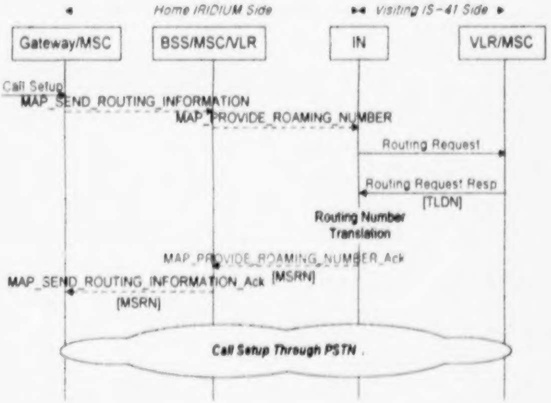

Visiting IS-41 Side
Home IRIDIUM Side
MS
BSS/MSC/VLR
IN
Gateway/HLR
Authentication Procedure With Registration
SSD-A
RAND
Auth
AUTHR
RAND
Registration Request
[RAND, AUTHR, Count]
Authentication Request
SSD-A
RAND
Auth
AUTHR
Authentication Request Ack
=
Registration Notification
MAP_UPDATE_LOCATION
MAP_INSERT_SUBSCRIBER_DATA
MAP_INSERT_SUBSCRIBER_DATA_Ack
MAP_UPDATE_LOCATION_Ack
Registration Notification Ack
Registration Request Ack

Figure 5. Registration procedure of the Iridium subscriber roaming in IS-41 network


Home IRIDIUM Side
Visiting IS-41 Side
Gateway/MSC
BSS/MSC/VLR
IN
VLR/MSC
Call Setup
MAP_SEND_ROUTING_INFORMATION
MAP_PROVIDE_ROAMING_NUMBER
Routing Request
Routing Request Resp
[TLDN]
Routing Number Translation
MAP_PROVIDE_ROAMING_NUMBER_Ack
[MSRN]
MAP_SEND_ROUTING_INFORMATION_Ack
[MSRN]
Call Setup Through PSTN

▨ : Processed only if IS41A or B

Figure 6. Terminating call procedure of the Iridium subscriber roaming in IS41 network

5. CONCLUSION

As people all over the world become increasingly mobile, global roaming between various types of mobile networks has a potential to become a highly profitable business and a powerful weapon in the future telecommunication market. In this paper, we took an example of roaming between Iridium mobile satellite network and IS41-based terrestrial networks and reviewed technical issues inherent in the roaming between heterogeneous networks. We summarized major differences between Iridium and IS41 networks in terms of subscriber identity, MAP protocol, call delivery procedure, and authentication procedure. Finally we proposed the implementation of roaming service by introducing an Interworking Node. Since Iridium protocol complies with GSM standard, proposed roaming scheme is easily applied to terrestrial international roaming between GSM and IS41 cellular networks without any modification of GSM network.

REFERENCES

[1] TIA/EIA/IS-41 Rev. C, "*Cellular Radio telecommunications Intersystem Operations*".

[2] GSM 09.02, "*European digital cellular telecommunication system(phase 2) : Mobile Application Part(MAP) specification*".

[3] ITU-T White book E.214, "*Structure of the Land Mobile Global Title for the Signaling Connection Control Part*".

[4] M. Mouly and Marie-B. Pautet, "*The GSM System for Mobile Communications*", 1992.

[5] IS-95A, "*Mobile Station - Base Station Compatibility Standard for Dual-Mode Wideband Spread Spectrum Cellular System*".

[6] GSM 02.17, "*European digital cellular telecommunication system(Phase 2) : Subscriber Identity Modules Functional Characteristics*"

Benefits of using Microwave Radio Links in Wireless Networks

by

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ABSTRACT:

The purpose of this paper is to highlight the current advantages of using microwave radios to provide infrasystem connections by reviewing technical and economic analysis of the various transport alternatives: copper, fibre, microwave. The paper will also preview new radio, antenna and packaging technologies which will provide network designers with increased flexibility, reliability, speed, and cost effectiveness in implementing microwave alternatives in their future wireless infrastructures.

INTRODUCTION

In the face of rapid change and complex technologies, wireless service providers responsible for choosing network transport must balance economics, security, performance, efficiency, and existing network issues against the pressures of market expansion, technological change, unpredictable subscriber preferences and competition. To a large extent, the profitability and competitive advantage of each company will hinge on the choices of these key decision-makers.

The proliferation of transport technologies also requires wireless service providers to assess the merits of several transport technologies in order to develop successful intrasystem connections. This paper outlines the economic and technical challenges of creating a wireless network transport infrastructure and demonstrates how microwave can meet these requirements more effectively than traditional leased line solutions.

This discussion will also describe new radio, antenna, and packaging technologies that provide wireless network designers unequaled flexibility, reliability, speed and cost effectiveness in implementing microwave in their wireless infrastructure.

INFRASTRUCTURE OPTIONS: LEASED LINES VS. MICROWAVE

Network operators have three basic infrastructure choices: copper, lightwave or microwave. In the past copper was traditionally used for new networks, but today's bandwidth-hungry applications make it unsuitable for expanding multiservice networks. Lightwave transport over fiber is an excellent choice for networks requiring capacities of 1Gbit/s or greater. However, a major impediment to fiber is its cost of installation, including the costs of right-of-way facilities and civil engineering. A second disadvantage of fiber is its vulnerability to route damage over long service times. Microwave transport offers technical and economic advantages when availability, cost-effectiveness, implementation time, security, and/or difficult terrain are significant system design considerations.

TRADITIONAL LEASED LINES

Leased lines typically include two basic components: the *access* portion (also known as the loop) and the *interoffice* portion. In most cases, these facilities are provided by the local serving company (known as RBOC or Independent Telco in the USA). The costs for these facilities are set by tariffs filed with the local regulatory agencies for a particular local access and transport area (LATA). The cost, quality and service offerings provided vary widely depending on the geographic area. Costs, for example, can range from $175 (U.S.) per month per T1/E1 to well over $1,000 per month[2].

Upon first examination, a $175/month T1/E1 line may look like a real bargain; however, there are several factors that must be considered when comparing the various aspects of digital transport facilities provided by leased lines and microwave radio:

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[2] These tariffs are for ***Inter-LATA*** circuits. Systems that require transport across LATA boundaries require the user to lease facilities from an inter-exchange carrier in addition to local access facilities. The total costs for this kind of system can be considerably higher.

1. Transmission Quality and Reliability
2. Circuit Availability and Reliability
3. Protection
4. Short-Haul Costs

These factors will be examined later to explain their effects on overall leased line circuit quality, accompanied by a comparison with microwave facilities.

MICROWAVE: A PROVEN CONCEPT

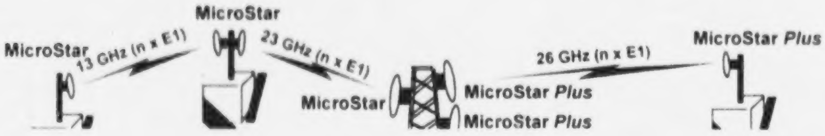
The emergence of small, low- cost high-frequency radios (13 to 38 GHz) now permits network planners to use microwave for short-haul network applications. For the backbone or high-reliability backup to fiber, modern high-capacity SDH microwave is also available. Digital microwave consistently provides the flexibility, reliability, and cost-effective rapid deployment characteristics critical to a wireless service provider's infrastructure backbone.

This level of reliability has been achieved through strict adherence to a clearly defined set of North American and international performance objectives. The medium has long been the transport technology of choice for meeting low- or medium-capacity needs using Plesiochronous Digital Hierarchy (PDH). In addition, microwave technology fulfills high-capacity requirements in the wireless market with Synchronous Digital Hierarchy (SDH), and also provides backbone access for Asynchronous Transfer Mode (ATM) multimedia applications.

While the specific needs of each service provider will ultimately determine the appropriate choice of transport, fiber spans and microwave links are often deployed synergistically as interconnected elements throughout many large networks. Fiber's high capacity makes it a good choice for traffic on the Internet. Microwave's ease of installation, security, and cost-effectiveness make it a good choice for carrying diverse media and lower throughput outside of the backbone and over spur routes. As a general rule, the installed cost of 10 km of fiber may be about the same as a link of radio that may extend over 50 km. A common guideline is to install fiber when the link bit-rate requirement exceeds about 1Gbit/s (16,000 equivalent voice circuits).

The following diagram illustrates a typical application of different microwave capacity and frequency choices for access and backbone:

PCN/Cellular Site Interconnection



FOUR FACTORS TO CONSIDER WHEN COMPARING LEASED LINES AND MICROWAVE RADIO

1) TRANSMISSION QUALITY AND RELIABILITY

The Residual Bit Error Rate (RBER) of a leased T1/E1 facility can vary widely depending on the condition of the serving company's plant. Generally, the interoffice portions of the trunk will have higher transmission quality than the loops. Most interoffice transmission facilities are provided by fiber or digital microwave, which typically provide a very low RBER usually 10^{-10} or better).

The loops are the "Achilles Heel" of most leased facilities. Local loops are usually provided via copper, which can provide sub-optimum transmission depending on the length (distance from the central office) and age. It is not unusual for old copper facilities to exhibit an RBER of 10^{-9} or worse.

Loops of several thousand feet may also include cable repeaters, which can exacerbate this situation. RBER values of 10^{-7} are not unusual on loops containing poorly maintained repeaters. This quality level, while satisfactory for voice applications, can prove unacceptable for data or teleconferencing.

By comparison, properly engineered digital microwave systems typically operate virtually error-free in the absence of high-level interference or severe rain attenuation[3]. A typical microwave system can operate with an RBER of 10^{-11} or better.

2) CIRCUIT AVAILABILITY AND RELIABILITY

Circuit availability is defined as the percentage of time during which the circuit is available for use. Availability is the complement of long-term outage (% availability = 100 - % outage) that causes traffic disconnects and downtime. For a leased facility, an outage begins when the transmission quality degrades to a point where it is considered unusable for transmission (usually a BER of 10^{-3} for a duration of more than three to nine seconds). At this point the circuit is released to the serving company for maintenance. The disconnect period ends when the repair is complete and the circuit is returned to the customer.

One prevalent service offering, the AT&T Accunet® T1.5, has a one-way availability objective for customer premises-to-customer premises circuits of 99.7 percent, which equals more than a day (26.3 hours) of accumulated traffic disconnect time during a one-year period. The 24-hour performance (short-term severely errored second outage and circuit quality) objectives are as shown in the following table:

[3] Digital Microwave Link Engineering (Sections I-V), Richard U. Laine, P.E., and Wiley Quan. Harris Corporation, Farinon Division, Redwood Shores, CA.

Table 1
Accunet® T1.5 Performance: (end-to-end)

Circuit Length (Airline Miles)	Errored Seconds /Day	% Error-Free Seconds	Severely Errored Seconds/Day
< 250	2246	97.40	4[4]
250 to 1000	2506	97.10	4
> 1000	2765	96.80	4

Interoffice facilities are usually protected, and long-term outages (traffic disconnects) do not usually result from failures in this portion of the circuit. A loop failure, on the other had, usually *does* result in a circuit disconnect. (See the section below on protection.) These short-term SES outage and quality limits can prove unacceptable for many critical applications.

By comparison, current ITU-R and Bellcore one-way outage and reliability objectives for microwave systems are summarized in the following table:

TABLE 2
ONE-WAY QUALITY OBJECTIVES, INCLUDING THOSE FOR A TYPICAL 25-MILE DIGITAL MICROWAVE LINK

	Very Short[5] Haul	Bellcore Short Haul	CCIR (ITU-R)	Long Haul
System Length	< 125 mi.	125-250 mi.	1500 mi.	4000 mi.
End-End Reliability	99.995%	99.995%	99.986%	99.995%
Per-hop outage SES/year	320	160	70	20
Annual per-hop reliability	99.999%	99.9995%	99.9998%	99.99993%

Close attention should be paid to the per-hop objectives in this table. These values are equivalent to the level of performance to be expected from a typical well-engineered microwave link used as an alternative to leased T1/E1 facilities. The numbers demonstrate that even the very short-haul microwave objectives are orders of magnitude better than the leased line objectives.

3) PROTECTION

The only way to improve the availability of any transport system is to utilize some form of protection, or redundancy. Periods of unavailability (traffic disconnect) are often unacceptable if not disastrous, to users. Protected (monitored hot standby) and ring (loop) microwave systems have been standard in all critical applications for decades. Protection, on the other hand, cannot be taken for granted in leased facilities. The availability and cost of protection for leased facilities varies widely depending on the geographic area. In many locations, protection is simply not offered in the standard tariff. In those areas where it is, it usually results in higher costs -- often more than double the standard (non-protected) tariff.

4) SHORT-HAUL COSTS

Fiber lines offer considerable capacity, but fiber isn't always available. As a user goes higher in capacity, microwave becomes much more cost-effective than leased lines. For most microwave users, the basic product offering is a four T1/E1 system, and the

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[5] No standards exist for Very Short Haul (< 6 hop) microwave systems, but typical objectives are shown.

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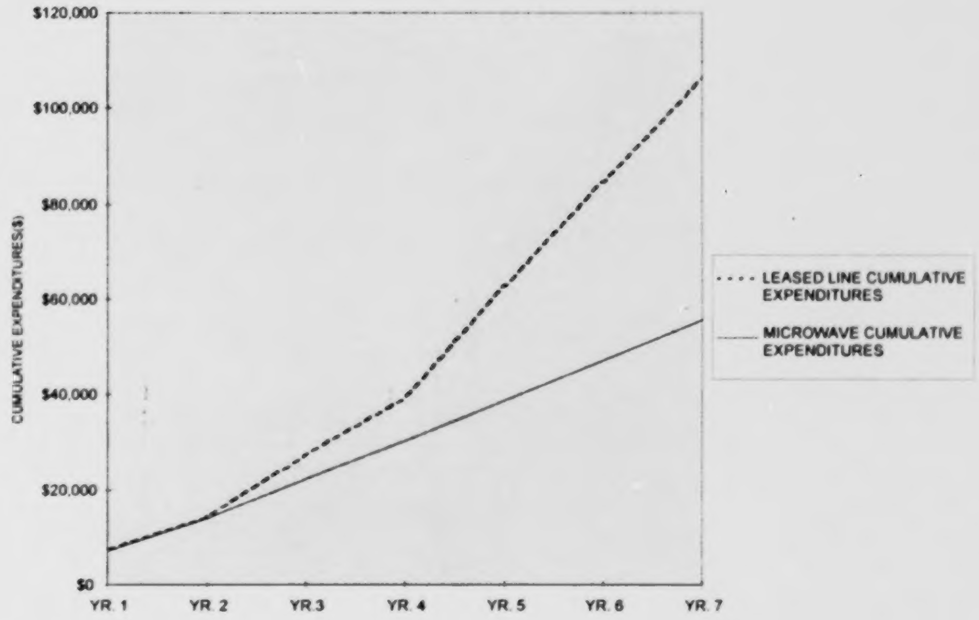
[4] Interim standard -- includes 4 SES/day for each access link.

installation includes one to four T1s/E1s for the same cost, with the next three T1s/E1s provided at no additional cost. With leased lines, the customer must lease three more trunks, and the cost of the facilities must be multiplied by four. The following chart shows a simplified cost comparison of leased line vs. financed microwave for short-haul purposes

COST COMPARISON
LEASED LINES VS. FINANCED MICROWAVE
(Short Haul)



LEASED LINE CALCULATIONS:

	Years 1-2	Years 3-4	Years 5-7	Total
No. of T1 lines:	1	2	4	
Hook-up Costs:	$1,000	$1,000	$ 2,000	
Mo. Lease Chg/T1:	$ 550	$ 500	$ 450	
Total Costs:	$14,200	$25,000	$66,800	$106,000

MICROWAVE RADIO CALCULATIONS:

	Years 1-2	Years 3-4	Years 5-7	Total
Monthly Lease Chg:	$333	$425	$455	
Monthly O&M Cost:	$250	$250	$250	
Total Costs:	$14,000	$16,200	$25,380	$55,600

Leased Lines Vs. Microwave: Additional Considerations

Construction time can be a factor in some cases with leased lines, depending on the area and availability of facilities. If a telco or serving company does not have digital facilities in a particularly area, it may take months to provide a leased T1/E1 facility. In some cases the customer may have to share a portion of the construction costs to provide the facility. Microwave systems are also deployed quickly, particularly in metropolitan areas where roof-top attachments are used in place of towers.

CONCLUSION: MICROWAVE IS THE BETTER CHOICE

On first examination, leased T1/E1 facilities may appear less costly than microwave in some LATAs. However, when circuit quality, availability and reliability are considered, properly engineered microwave systems have been shown to be clearly superior. Protection, a standard feature of microwave systems, cannot be taken for granted in leased facilities -- and can increase the cost of these facilities. Clear channel facilities, a necessity for many present day applications, are standard on virtually all current microwave equipment but are not available on all leased lines. Where CC is available, it invariably comes at an increase in cost.

Low-cost leased T1s/E1s are available in some areas, but they are invariably non-protected, non-clear channel, single T1/E1 facilities. In most applications, microwave remains the clear choice for expanding network needs.

Digital microwave systems provide unequaled transmission quality and reliability to meet the complex needs of wireless service providers. Point-to-point microwave radio systems have delivered effective services for a wide range of applications since their first use more than 50 years ago and continue to offer a compelling and cost-effective alternative to other transport media. As the industry moves forward, radical new antenna designs (e.g. MicroStar® *Plus* from Harris Corporation, Farinon Division) will emerge to provide unparalleled flexibility, reliability, speed and cost-effectiveness in implementing microwave into a wireless infrastructure.

Tuesday, January 13, 1997

NOTES:

The Market Trend for Cellular Mobile Phones and Its Impact on the Life of the Chinese People

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Shanghai, China PR

ABSTRACT

It is relatively late for the cellular mobile phone to be a favorite for Chinese users. However, with its advantage in portability, it is welcome to more and more Chinese and gradually becomes a hot commodity in the society. This paper discusses the market trend for Cellular mobile phones and its impact on the live of the Chinese people.

As is shown in human history, the development of any society is largely subject to the means people use in their communication. It is almost clear to all that the skills in paper making and the advanced technology in printing once made great contributions to the achievement of the ancient Chinese civilization. However in the last century or so, China was relatively backward in many ways compared with the more advanced Western civilization. Now China is again experiencing a period of fast development and this is of course being done with the matching progress in the means of communication. One of the most impressive in this communication revolution is the recent growth in people's use of the Cellular Mobile Phones.

1. An analysis for the Current Market Situation of Cellular Mobile Phones

1.1 Growth Situation

The Cellular Mobile Phones, popularly known as "Dageda", "Hand Phone", or "Portable Phone", though relatively late to get started, have entered the market at a high level. With the rapid, continuous and stable development of the national economy, the cellular mobile phone is highly welcome to the Chinese people because of its advantages in its portability, applicability at any time and space. It has definitely become one of the hot commodities in the current society of China and the end of this trend is hardly to be traced.

In China the application of cellular mobile phones started in 1980's. The nation's first TACS- 900 MHZ simulation cellular mobile phone system was opened in Guang Zhou in 1987. After that, Shanghai, Beijing and other cities successively opened the service for cellular mobile phones. In 1988, the number of the phone users were only about 3000, with 30000 capacity of exchangers, and total information channels of 381. At the end of 1993, phone users amounted to 646000, with 1560000 total capacity of exchangers and 29325 information channels. In 1996 the phone users in the network went up to 6500000, with 13717000 total capacity of exchangers. (The Statistics Year Book of China, 1994, 1995, 1996)

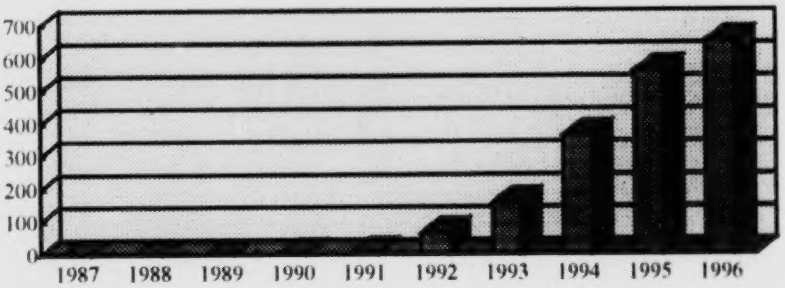

Fig. 1 The growth of cellular mobile phone users in China

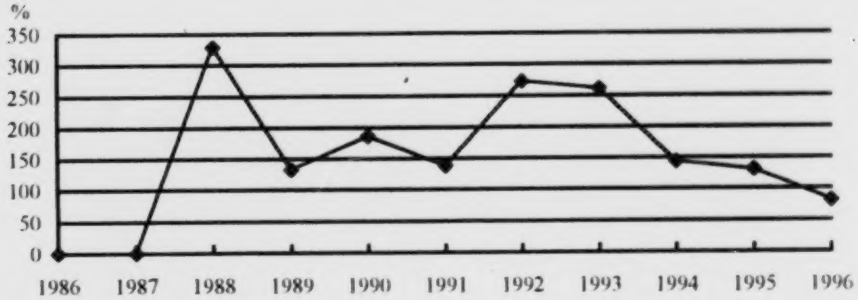

Fig. 2 The yearly growth rate of cellular mobile phone users in China

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As shown from the above, the yearly growth rate of the cellular mobile phone users before 1993 had been kept over 200%. Although the growth rate after 1994 has not been as high as those before 1993, its growth rates are still very impressive.

At present the cellular mobile phones in China are classified into two categories. The digital system and the analogue system.

Judging from the market trends in China, it can be estimated that at the end of this century, the total capacity of its installations would be well over 50000000 units. With more and more people who have purchased the phone, the growth rate would gradually drop to about 30% at the turn of the next century. Despite the great strides in its development, the density of cellular mobile phones in the nation's communication system would still maintain at a low level of about 2%. It is estimated that in the year 2000 the population of China would reach 1300 million, so that the demand in terms of its number of units would still on the increase.

1.2 Market Analysis

1. The domestic market of China is now largely occupied by foreign cellular mobile phones, with domestically manufactured ones little known to the consumer. Most Chinese users have their preferences to foreign brands.

A popularity survey on brands reveals that foreign brands enjoy high popularity. The most important factor for the customer to make their decision as to which brand of cellular mobile phones to purchase proves to be the quality of the product. Many consumers tend to equalize the choice of a foreign brand of cellular mobile phone to that of the product quality. Some customers care less of its price, but are ready to pay more for good quality products. This tendency, to a certain extent, is also seen in customers' decisions on making choices as to which brand of products to buy when they buy home made phones.

2. The acceptance and prevailing of cellular mobile phones varies noticeably with areas. Customers in different areas favors different brands of products. For example, the users of the Changsha analogue network system favor NEC, while those of the Beijing analogue network system are largely Motorola lovers. Causes of such phenomenon are rather complicated: Apart from the Chinese people's psychological tendency of "it is safe to follow the crowd", the time for a brand to enter the market, the forcefulness of its advertisement and publicity, and the product quality, etc. are also significant factors. Among them quality plays a major role in acquiring the market share.

3. The style of a hand phone is, in many cases, very important to the customer. The survey tells us that 19% consumers take style as their first priority in selecting their hand phones. Now people generally are fond of good looking, easy handling, small sized phones. More specifically, the uniqueness in its design proves to be a good feature to attract particular groups of customers.

4. The price level to a certain degree affects the purchasing behavior of the customer. The survey tells that for about 14% customers the first priority is given to price terms. On the whole those with such ideas do not account for a high percentage. However, in certain particular areas, the percentage of such people is very high, showing that in some areas the level of price is still a key factor for certain customers. This also has something to do with the fact that there are more and more people who have become users of this commodity. With the intensifying competition in the market place, the price competition is gaining in importance. It is clear that those who can offer high

quality products with competitive prices will finally become the market winners.

5. The digital hand phone presents good sign of development, but the analogue type is not out of date. The survey shows that in China analogue and digital telephone networks enjoy their respective advantages. Therefore both have their own strengths in the market and enjoy different market demands. The digital style has become a favorite because of its advanced performance and remarkable feature in confidentiality while the analogue is welcome for its wide coverage and high stability. Further efforts in promoting the analogue hand phone will still keep its market thriving in the days to come.

2. A Trend Study

2.1 Trend analysis and prediction

The advent and development of any communication service are subject to the availability of a certain technology which is able to support it, and to the availability of the market condition required. In terms of technology, the analogue mobile communication technology has already reached its maturity stage. The digital mobile communication technology, GSM, is now moving towards its maturity stage and has gone into operation in China. The CDMA technology will soon become stable and step into commercialization in a matter of years. The digit-based second and half generation products, such as, PCN, PCS, DETC and the third generation personal communication technology as FPLMTS, etc., will see great advances in the next 5-10 years. In view of the technology development, the next five years will see the speeding up of digitalization of cellular mobile phones. It is certain that the GSM and CDMA technology will be further applied and expanded. During this period, the movable cellular mobile phone communication system will play an important role in China.

From the analysis of the market conditions, the major current problems which hinder the progress of movable communication system in China are in the following:

1. The networking among different systems offered by different manufacturers; 2. The lack of unified administration and frequency programming, resulting in the waste of frequency resources due to poor coordination; 3. In the coast areas, the problem in base positioning makes it difficult for the increase of the system capacity though the demands are high and the capacity for user application is expanding rapidly; and 4. The market competition for cellular mobile phones has forced the business sectors in telecommunication network to promote their new services with new technologies before its due time really comes. Now it has become a fact that in the coast areas the GSM technology has been adopted to speed up the process of digitalization.

It is rather clear that in the recent years both the analogue and digital cellular mobile phone systems will experience a period of development. After that, the growing speed of the analogue cellular mobile phone will slow down and then gradually be replaced by the digital system.

2. The acceleration in localization

Experts estimate that in 2000 the annual sales of cellular mobile phones in China will reach 100 billion yuan RMB (Renmimbi). At present the market for cellular mobile phones is in a period of growth, offering a large room for development in the manufacturing sector of China. This is a good opportunity in the competition arena for the mobile telecommunication industry. Now in the home market of China manufacturers from both home and abroad are competing with each other. At this stage, 98% of the market share is covered by foreign made products. In order to enhance the competitive position many domestic companies are seeking to form joint ventures, to introduce production lines and technologies, and to develop home made products. These efforts will gradually result in the commercialization of new brands of home made cellular mobile phones.

3. More intense competition among the brands

With the approval of more styles of hand phones by the Post and Communication Department, in the our limited market space the competition between different brands in their efforts to secure the users will be more intense than ever before. The future competition in the market will be multi-dimensional--manufacturers of different brands will compete with each other in such respects as, quality, design, price, after-sale service etc.. In the future, the hand phone will be characterized by multi-application, small size and high powered batteries.

4. Further decrease in price

At present the hand phone sales price varies, with the general trend presenting further decline in its price. There are several reasons for this trend:

(1) With the rapid growth of the joint companies in the cellular mobile phone market and the participation of the military sector, their competition with the post and telecommunications organizations will be more intense. Apart from the competition in quality and after sale service, the major competition will be that in price. This will make the price of hand phones further decline.

(2) The price will further drop due to the intensifying competition among the foreign companies in the domestic market of China, the enlarging of its production scales, and the decrease in tariff barriers.

(3) The decrease in its prices also comes from the mushrooming of domestic manufacturers, the increase in the localization rate of the product and the effect of Hong Kong's return to China.

For now the promotion policy of certain areas in China is based on the cost price of the hand phone. The market share oriented rather than profit oriented promotion policy is gradually accepted. It is estimated that in the years to come the post and communication departments will adopt the strategy of leasing and selling at lower than cost prices. It is very similar to the situation with the BP phone market where the major income comes from the communication charges instead of profits from telephone sales.

Besides the application fee to enter the network will also decrease by large amounts and the service will be charged from one side instead of two sides.

3. Estimation of the Total Market Demand

The market includes the three factors, namely, the population, its purchasing power and the want to purchase. The relationship is shown as follows:

Market = population x purchasing power x customer want

China is a large country with a population of over 1200 million. It is estimated that at the end of 2000 the population will reach 1300 million. In terms of purchasing power there are substantial differences between the eastern and western areas due to the geographically unbalanced development of the nation's economy. Statistics show that the Engel coefficient has dropped to below 30% in the more developed eastern areas, 30-50% in the middle areas, but in the western areas it still remains somewhat over 50%.

In a competitive market there are various factors influencing customers' demand. The relationship can be expressed in the following function:

$$Q = f(P, T, I, Pc, Ps, E, \omega, \alpha)$$

where,

Q--market demand for a particular commodity,

P--price

T--taste of the customer

Pc--price of substitute commodity

Ps--price of supplementary commodity

E--estimated variation in price

ω --savings of the customer

α --other factors

The above equation states, the market demand of the customer for a certain commodity is a function of many variables. Economists say, for a particular commodity in a specific market, most variables influencing the demand will change very little. For example, the customer taste, their income level and the prices of substitute commodities will change gradually and their impact on the demand is not direct. Therefore, they are negligible in our level of analysis as well as in study of the market demand. Given that other factors remaining unchanged, the calculation can be done with the following simplified equation:

$$Q = nqr$$

where,

n--total population

q--average purchased amount per person

r--modification coefficient

As in the case of China,

$Q= 13 \times 1 \times 0.02 = 36$ (million units)

The calculation tells us, the total market demand of cellular mobile phones would be 36 million units, about ten times as much as it was in 1996, leaving great room for further development. Even if this comes true, the rate of average possession would only be 2%, well below the over 25% level for developed countries. In a word, required by the national economic development, telecommunications industry in China will grow in great strides and this in turn will have a substantial positive impact on the development of the nation's economy, and also the life style and quality of the Chinese people.

The entering of cellular mobile phones into the life of many Chinese people is brought about by the development of communication technology. The significance of such change is beyond the scope of the domestic market itself. The progress enjoyed by the Chinese people in the ease of their communication has changed and is still changing the social and cultural aspects of the Chinese people in many ways. Culture is defined as a shared perceptions. The sharing may stem from common experience produced by ethnicity or nationality, but it could also stem from any common experience. (Fontaine, 1989) Now in big cities like Shanghai, people's possession and use of hand phone has become a scene anywhere--in the street, at a public location, in the car, in the office and even in school classrooms. Many people, especially those who are doing business, would prefer to have a hand phone with them because they do not want to miss the prompt information which might be important to the success of their business or career development. Many people interviewed have expressed to the author and interviewer, saying that they are will to pay a large bill for the cost of keeping themselves better informed. Generally large expenses in telephone bills imply one's social status or success in the society, or both. (Fang, 1997) Although we can not understand that the relationship between one's success and his/her bill in communication is always positively proportional, there is something that we can see from what is in those people's mind. The prevailing of cellular mobile phones is not only a cultural phenomenon in China today, but also is contributing a lot to the formation of a new revolutionized culture in the future. What the end picture will look exactly like is still remaining unseen.

References:

Fang, Jun, An unpublished *Interview*, conducted by David Zhao in Shanghai, China, 1997.

Fontaine, Gary, Managing International Assignments: The Strategy for Success, Englewood Cliffs, Prentice-Hall, 1989.

National Statistics Bureau, The Statistics Year Book of China, China Statistics Press, 1994, 1995, 1996.

Regulation Policy of Mobile Communications in Korea: Retrospect & Alternatives

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1. Abstract

The deregulation policy of mobile communications in Korea could result in privatization and mitigation of entry restriction. But the radio spectrum was hardly recognized as a resource until early 1990s. With the amendments to telecommunication-related laws and new grants of mobile communication carriers, some important changes have been under way. The mandated contribution to R&D fund by newly licensed carriers appears to be an effective way of diverting the economic rents of the radio spectrum from the carrier. The present dual radio spectrum allocation system, licensing of new carriers and authorization of radio station, hinders efficient utilization of scarce radio spectrum resources. This paper proposes a new regulation scheme for efficient use of radio spectrum in the era of more competitive and open economies.

2. Introduction

The mobile communication industries in Korea have grown rapidly since mid 1980s. With the growth of industries, there have been also some changes with respect to regulations. They are the several amendments to related laws and introduction of competition and privatization. This paper reviews the features of deregulation policy in terms of legal systems and market from mid 1980s to mid 1990s. This retrospect could provide the basis for the evaluation of deregulation policy from mid 1980s. And this paper contemplates the meaning of new carrier selection procedure, the R&D contribution systems from the viewpoint of spectrum management. Through this study, it is possible to make clear the cause of the conflicts between the mobile communication carriers and the policy makers. And the results of this study could provide the guideline of the alternatives of spectrum management policy.

3. The deregulation processes since 1980s

3.1 The legal systems

The modern legislation in the telecommunication fields has arisen from the Telecommunications Law initiated in December 1961. It governed the telecommunication policy and service provision and prescribed the telecommunication services as administrative affairs. At that time, the basic telecommunication facilities were insufficient. The immediate problem was to increase the basic telecommunication facilities such as telegram and telephone. In early 1980s, the Ministry of

Communications (MOC) divided the Telecommunications Law into the Telecommunications Basic Law and the Public Telecommunications Business Law. The former described the fundamentals to promote the development and efficient management of telecommunication matters. The latter governed the management of public telecommunications business, service carriers and service utilization. In conformity with this legal change, MOC separated its communication service part as the Korean Telecommunications Authority (KTA).

After these laws were amended twice as a whole in August 1991 and April 1995, the current Telecommunications Basic Law and Telecommunication Business Law were created forming the legal structure to handle the telecommunications policy and business. [4]

Besides these two laws, there was another law related to radio spectrum. The Radio Wave Regulation Law was established in 1961. This law was mainly comprised of the surveillance of illegal radio spectrum utilization and administration of port operation services for safe navigation. Especially under the tension between South and North Korea, the inspection of trans-border radio frequency was its main purpose. The backgrounds for the development of the radio communication services and industry were not solid.

Until early 1990s, the mobile phone service has been recognized as a supplementary service to general subscribed wireline telephone. The mobile phone service was classified as a mobile subscribed telephone of wireline telephone services.

With the economic growth in mid 1980s, the needs for mobile communications have been rapidly increased. For the purpose of promoting the radio communication industry and mobile communications services, the Radio Wave Regulation Law was amended and renamed as the Radio Wave Law in December 1991. To the amended Radio Wave Law, some important changes were introduced. They were the declaration of MOC's responsibility for security of newly available spectrum band and the reallocation of radio spectrum. This was viewed as a reflection of the importance of radio spectrum management. The policy makers began to consider radio spectrum as an essential intermediate good for the mobile communication services. With this view, the mobile communication services were defined as 'communication services using the assigned spectrum frequency' in amending the Telecommunication Business Law in April 1995. It was the first time to use the terms of assignment and frequency in the definition of the mobile

Table 1. The Changes in regulations on the Mobile Communications Carriers since 1980s

	Dec 1983-Aug 1991	Aug 1991-Apr 1995	Apr 1995 -
Law	Telecommunications Basic Law Public Telecommunications Law Radio Wave Regulation Law*	Telecommunications Basic Law Telecommunications Business Law Radio Wave Law	Telecommunications Basic Law Telecommunications Business Law Radio Wave Law
Type of provider	public common carrier	Specific Service Provider	Network Service Provider
Definition	Designated suppliers who are authorized to supply mobile communications services	A common carrier, who owns telecommunication networks and provides the technically and geographically limited services with the approval of MOC	A common carrier, who owns telecommunications networks and provides the services using the assigned radio spectrum with the approval of MIC
Entry Procedure	Designation	Approval	Approval

*) The Radio Wave Regulation Law was in effect till December 1991

communication services.

3.2 Deregulation: privatization & mitigation of entry restrictions

With the establishment of the Telecommunications Basic Law and Public Telecommunications Business Law in 1983, MOC started to consider the telecommunication services as business. But the deregulation was introduced in 1990s. There were some reasons for this delay: firstly, the basic telecommunications facilities were absolutely insufficient till late 1980s; secondly, the political confrontation between South and North Korea restrict the radio communications strictly.

MOC decided to deregulate the mobile communication services in July 1990.[11] The content of deregulation was to introduce competition and privatization. For the introduction of competition, MOC did intend to approve new mobile communications carriers and to place the monopolized mobile communications carriers of Korea Mobile Telecommunications (KMT) under private management. The deregulation process has brought the political and economical power games. The Taehan Telecom, a subsidiary of SunKyung (SK) Group, obtained new approval. But the Taehan Telecom returned the license for some political reasons in August 1992. After some compromising processes, MOC approved Shinsegi Telecom; the sole consortium composed of 246 companies, as the 2nd mobile phone carriers. The SK Group was rewarded as being a large stockholder of KMT(1). (12) Shinsegi Telecom commenced the commercial digital Code Division Multiple Access (CDMA) mobile phone service in April 1996. The mobile phone services entered into the competition era only after April 1996. In comparison with the stumble and delay in the mobile phone service, paging service began its competitions as scheduled in May 1993.

In accordance with the amendments to the telecommunication-related law in 1995 and new grants of mobile communications carriers in 1996, some important changes have been underway. Especially, the mandatory R&D contributions systems are introduced. The procedures of selecting new carriers consist of two stages. The first is to evaluate the proposal of each applicant. The second is to evaluate the R&D donation plan. The first stage is evaluated according to 6 factors, ① feasibility of telecommunications service provision, ② efficiency of the telecommunications facilities, ③ financial background, ④ R&D achievements and plans, ⑤ technical capacity, and ⑥ reasonability of consortium. The criteria for the second stage evaluation is the amount of proposed R&D contributions. The more R&D contributions are given, the higher grades are. But the amount of R&D contributions could not exceed the predetermined cap. If the proposed amounts were equivalent, the lottery method would be utilized. As there was a concern about lottery method, the Ministry of Information and Communications (MIC)(2) decided to enforce the first stage in selecting unique candidate. And the selected candidate should fund the same amount of pre-determined R&D contributions. [14] The amounts of R&D contributions are in variation. In case of PCS, the R&D contributions were approximately 129M$; in the case of TRS, they ranged from 1.29M$ to 8.25M$ according to service area. Through this new system, 19 new mobile communications service carriers were approved as of June 1997.

The incumbent mobile communications carriers are summarized in table 2.

The features of deregulation in mobile communications fields could result in privatization and mitigation of entry barriers. By privatization, SK Telecom could be a private enterprise owned by SK group. By the mitigation of entry barriers, large companies such as LG group and Hansol could enter the mobile communications service market. But the line-of-business regulations still remain. Therefore, the new carriers could provide only one service except paging carriers.

4. Evaluation of deregulation policy

The evaluation criteria for regulation policy are the considerations of spectrum resources as an essential intermediate good for mobile communications services and the economies of scope as the characteristics of mobile communications services. [1]

The recognition of spectrum as a scarce resource was introduced firstly in April 1995 through the amendment of the related law. For fair use of radio spectrum, there should be plans to restore economic rents. The R&D contribution systems seem to be a method of restoring economic rents of the radio spectrum. And the amounts of R&D contributions might be regarded as the shadow price of spectrum band.

However, the Korean spectrum management policies still focus on the management of radio stations. Under this spectrum management system, the present approval procedure of new mobile communication service carriers is just to select the subject of spectrum assignment. MIC states that the substantial spectrum frequency assignments are realized through the process of authorization of each radio station. The new common carriers regard the R&D contributions as payments for the value of spectrum band. Therefore, they think that they have the usufructuary right of spectrum band simultaneously with the remittance of the proposed R&D contributions. The government decides that the rights are in effect from authorization of each radio station. These conflicting views stem from the ambiguity of the definition of rights of spectrum.

Through the new carrier selection procedure in June 1996, MIC declared that the incumbent mobile phone service carriers could not enter PCS market. The government also announces that there may be additional spectrum assignment for PCS to them after successful commercialization of digital CDMA mobile phone service. The government's decision does not seem to reflect the economies of scope as the characteristics of mobile communications services. [1]

As we can see the spectrum assignment principles depend mostly on the discretion of the government. And the carriers' rights of spectrum are ambiguous.

5. Alternatives

Table 2. The incumbent mobile communications carriers in Korea as of Dec. 1997

Service	Introduction	Competition	service area	Carriers
Mobile phone	1984	Apr. 1996	nationwide	SK Telecom, Shinsegi Telecom
Paging	1984	Aug. 1993	nationwide	SK Telecom
			local (8)	Local paging carriers (8)
TRS	1988	1997	nationwide	Korea TRS, Anam Telecom
			local (8)	Local TRS carriers
CT-2	1997	From Beginning	nationwide	KT
			local (8)	Local paging carriers
PCS	1997		nationwide	KT Freetel, Hansol PCS, LG Telcom
Mobile Data	1997		nationwide	Airmedia, Intech, Hanse Telecom

* The underlined are new carriers after the introduction of competition.

The present spectrum assignment mechanism is suitable for traditional private mobile communications. From the viewpoint of traditional private mobile communications, the radio spectrum is considered as a common property resource and a public good. Under that concept, anyone who obtains the radio station authorization could be a co-user in the spectrum band. This is the open access method. At that time, the main role of the spectrum management was to manage the radio stations. But the commercial mobile communications industries are different in the utilization mechanism of spectrum band. The spectrum band assigned to a certain mobile carrier could not be shared with other carriers. This means that the carrier has the exclusive rights to the assigned frequency band of spectrum. Therefore, to clarify the definition of carriers' rights of spectrum and the management scheme of spectrum band is more important in spectrum management. These environmental changes require the development of a new spectrum management mechanism suitable for commercial mobile communication services. Under this new mechanism, the carriers' right of the spectrum band could be clearly defined. The rights of spectrum could span from tenure of the U.S. to property rights including transfer rights or loan rights of the New Zealand and Australia. And the authorization process of radio station should function as the process of service coverage expansion. Under this spectrum management system, the new carrier selection procedure would function as a resource allocation process in reality. For the introduction of this new system, it is a prerequisite to conceptualize the radio spectrum as economic goods.

The trends of global openness also require the establishment and practice of fair and transparent rule in regulation policy. After the inauguration of WTO, it seems that the market opening discussions focus on the intermediate goods. The examples are the blue round and technology round. These new rounds focus on the intermediate goods such as labor and technology. In the long-run perspectives, these trends would influence on the pursuit of the global generality of resource allocation mechanism. And the new trans-border services of the system and the global coverage such as GMPCS also require commonness in the regulation schemes. These environmental changes also request the transparent and distinct regulation schemes.

6. Conclusions

This paper reviews the deregulation policy in mobile communications in Korea since 1980s and proposes new policy schemes. The contents of this new scheme are the development of spectrum management system suitable for commercial mobile communications services. There should be compromise and cooperation among the government, mobile communications industry and users. The ultimate object of spectrum management policy is to derive a method of maximizing the social welfare.

References

[1] Amendola, G. and A. Feraiuolo (1995) "Regulating Mobile Communications," *Telecommunication Policy* 19 (1), 29-42.

[2] Baumol, W. J. and R. D. Willig (1985) "Telephones and Computers: The Costs of Artificial Separation," *Regulation* (March/April): 23-32.

[3] Brennan, T. J. and K. Palmer (1994) "Comparing the Costs and Benefits of Diversification by Regulated Firms," *Journal of Regulatory Economics* 6, 115-136.

[4] Chin Cho, et al (1996) "Restructuring the Korean telecommunications market: Evolution and Challenges ahead" *Telecommunications Policy* 20 (5), 357-373.

[5] FCC (1995) *Regulatory Treatment of Mobile Services*, 3rd Further Notice of Proposed Rule Making (May 5).

[6] Huang, D. C. (1993) *Managing in the Spectrum: Win, Lose or Share*, Center for Information Policy Research, Harvard University Press.

[7] Minasian, J. R. (1975) "Property Rights in Radiation: An Alternative Approach to Radio Frequency Allocation," *Journal of Law and Economics* 18, 221-272.

[8] Ministry of Commerce New Zealand (1994), *Radio Spectrum Management*, Available at http://www.govt.nz/com/rsp/pib17.html

[9] Ministry of Commerce New Zealand (1995), *Radio Spectrum Management 1994-95*. Available at http://www.govt.nz/com

[10] Ministry of Communications in Korea (1990) *The restructuring plan of communications industry for the introduction of competition*, originally in Korean.

[11] Ministry of Communications in Korea (1994) *The Annual Report of Telecommunications*, originally in Korean.

[12] Ministry of Information and Communications in Korea (1995) *Request for Proposal of New Common Carriers*, originally in Korean.

[13] OECD (1993) *The Economics of Radio Frequency Allocations*, OECD, Paris.

[14] U.S. (1995), *code of federal regulations 47, Telecommunication*, revised as of October.

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(1) KMT was renamed as SK Telecom in April 1997.

(2) According to the government reforms, MOC was reorganized as MIC in December 1994.

(3) Numerous Korean Companies participates in GMPCS business. Korean Telecom, Samsung Electronics, Shinsegi Telecom in ICO, Dacom, Hyundai Electronics in Global Star, KumHo Group in Odyssey, and SK Telecom in Iridium. The Korean representatives comprised of the Governments, Research Institutes and related industries contribute to the preparation of GMPCS MoU. The Korean representatives take charge of the leader of Project Team 3 (Custom Arrangement and Access to Traffic Data) and vice chair of GMPCS MoU Meeting. Especially, the Korean representatives assume the important role of compromising the conflicting opinions between the developing countries and the developed countries.

Selection of Modern Telecommunication Media and Dynamic Route Guidance System for Intelligent Transport System

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1. ABSTRACT

The objective of this paper is to help organizations select a suitable telecommunications media and dynamic route guidance system(DRGS) for an intelligent transport system (ITS) taking into account both cost and functionality. The media selection criteria and wireless communications for an ITS are discussed along with various DRGS. We describe which kind of telecommunication media and DRGS are suitable. The strategy of an ITS in Korea is described in regards to telecommunication media and DRGS.

2. Introduction

The objective of the traffic management system in ITS is to promote safe and smooth flow of traffic by naturally distributing the flow of traffic, which is done by guiding cars to the appropriate routes in accordance with drivers instinctive desire to reach their destinations quickly by avoiding traffic congestion. Based on information gathered from street network, this system can help drivers find the optimal traffic flow. The aims of the system are to promote safe driving, to lower the pollution and to provide shorter travel time to the drivers. The messages given to drivers are the results of the optimization. Such traffic management system can be implemented by using two-way communication. Future road traffic systems must use an existing communication infrastructure, so that the cost can be reduced. Two-way communication enables cars to work as sensors. Cars measure their own travel times and locations and send the location and travel time on the uplink to the traffic control center. This allows better traffic modeling, prediction, and route calculation. On the downlink the vehicle equipment receives new traffic information from the traffic management center. There are several prerequisites to be considered. The first prerequisite is to keep the costs of information, provision of this information, and number of onboard devices as low as possible. The second is to adopt several methods of information provision to encourage the development of onboard devices to suit a wide range of driver needs, and to provide information via several different media to enable drivers to select the medium for which each was developed (4, 9).

There are five ITS systems to be developed in Korea: (1) Advanced Traffic Management System (ATMS), (2) Advanced Traveler Information System (ATIS), (3) Advanced Public Transportation Systems (APTS), (4) Commercial Vehicle Operation (CVO), and (5) Advanced Vehicle and Highway System (AVHS). ATMS involves traffic control, incident management, electronic toll collection, and heavy vehicle monitoring systems. ATIS involves traffic and road information, en-route driver information, route guidance, traveler service information, and pre-trip traveler guide systems. APTS involves public transportation information and public transportation management systems and gives transit priority to public transportation vehicles by setting priority signal control and priority lanes, thereby improving travel convenience of bus commuters. CVO involves commercial-vehicle electronic clearance, freight and fleet management, hazardous material monitoring, on-board safety monitoring, and automatic roadside inspection systems. AVHS involves vehicle and highway systems (5, 6, 11).

These systems are to be implemented one by one in Korea. At this point, ATIS and CVO are being developed and are focused on in this paper because of ITS's marketability. So, this paper introduces the wireless communications and media selection criteria for implementing these systems. We describe various telecommunication media for various environments and users for developing these systems. Another purpose of this paper is also to help organizations select the correct DRGS using advanced telecommunication media because DRGS is the most important part of ATIS. Several kinds of DRGS are discussed to decide the suitable DRGS for ATIS in Korea. Finally, the strategy of ITS is discussed based on the selection of telecommunication media and DRGS. It is expected that we can reduce the national cost of logistics and raise the operation efficiency. Also, we can build national competitiveness and improve the logistics service for the people.

Section 3 discusses the modern wireless telecommunication media for ITS. Section 4 introduces several kinds of DRGS. Section 5 describes the strategy of Korean ITS based on the suitable selection of telecommunication media and DRGS. The system configuration of ITS is also introduced in this section.

3. Modern telecommunication media of ITS

The telecommunications media have different implementations and running costs depending on the requirements of the area (urban, interurban, rural, and remote), users (road authorities, emergency services providers, fleet vehicles company, vehicle passengers, and pedestrians), and message classifications (fixed, semi-static, dynamic, and traffic management information). The system depends on the requirements to determine where the networks will operate from, what infrastructure exists now, and how the networks will be controlled. Modern wireless communications are introduced and considered for telecommunication media of ITS in this section. The following are the discussion for the telecommunication media as shown in Table 1 (1, 3, 7, 8).

The coverage area of AM subcarrier is limited more by interference and propagation than by terrain. AM has been envisioned to provide roadway conditions over a large geographic area using ground wave propagation. The data AM subcarrier could supply information that does not change rapidly. The coverage area of FM subcarrier is limited more by terrain and multipath effects. FM subcarrier could provide a similar service as AM subcarriers but over a smaller coverage area or it could be used to provide real-time traffic and roadway conditions, advertising, and a host of other information over a short to medium range (30-50 mile radius).

Low Earth Orbiting Satellites (LEOS) and Geosynchronous Satellites (GEOS), can provide data or voice communication over a very large area. They are not limited by terrestrial infrastructure requirements. The commercially available systems are expensive for individual users, but medium to large companies that require communication with individuals may find them beneficial in rural areas. In urban areas, the systems are good complement to terrestrial systems and may offer some advantages when the terrestrial systems reach capacity.

The cellular radio networks include Enhanced Specialized Mobile Radio (ESMR), Global System for Mobile Telecommunications (GSM) or General Packet Radio Service (GPRS), and wireless data communication. ESMR uses advanced digital vocoders to provide enhanced services. Typically, it can provide telephone, dispatch, paging, fax and data services. Power at the base stations is limited to enable frequency reuse. It is available, according to vendors, throughout most of the country and is a competitor in rural areas to cellular service due to its lower infrastructure cost in available spectrum. In the original concept GSM offers a point-to-point connection especially for handling large data volume (e.g. file transfer). However, in an road traffic application small data volume usually occur. It is much more efficient to transmit these small size of information via a packet-oriented service. Therefore, GPRS has an advantage over the existing data services of GSM. Wireless data communication is the cellular packet-switched data network, in which the data stream is separated into shorter units called packets.

Cellular telephone provides links to both analog voice and data. For ITS services, Cellular Digital Packet Data (CDPD) is envisioned to provide the datalink for the cellular system. Personal Communication Services (PCS) is very similar to the cellular telephone service. The coverage is almost complete in many urban areas and extends well into rural areas surrounding these urban centers.

Dedicated Short Range Communication (DSRC) is defined as a short range communication system, using electromagnetic waves to provide either one-way or two-way communication, between a fixed roadside transceiver and transponders mounted onboard moving vehicles. By definition, DSRC provides localized coverage with gaps which are not covered by roadside transponders. A DSRC system consists of a fixed/transportable roadside/railside radio frequency (RF) reader (i.e., a transmitter and receiver, with significant information storage and processing capability), as well as a RF transponder on moving vehicles/trailers/cars which communicate by electromagnetic waves using a band of RF spectrum to provide various services. DSRC systems are normally used in a line-or-sight mode and are dedicated to transportation applications.

4. Dynamic route guidance systems

ATIS eases traffic flow by providing drivers with appropriate information on congestion, accidents and travel time to a particular destination. DRGS is the most important function of ATIS. DRGS enhances travel convenience by recommending to a driver the optimal route to his destination: DRGS can also reduce congestion by diversifying travel routes. There are several kinds of

Table 1. THE COMPARISON OF ADVANCED WIRELESS TELECOMMUNICATION MEDIA FOR ITS

Type	Data rate up to	Cost for infrastructure	Cost for In-vehicle	One or Two way	Scope of service	Characteristic
TRS	18kbps, ESMR 19.2kbps	low	medium	Two-way	limit(ESMR is city and rural area)	Circuit switched, Service for voice and data
GSM GPRS	GSM 2.4kbps-9.6kbps GPRS 9.6kbps	low	medium	Two-way	limit	GSM Circuit switched, GPRS Packet switched (Size of packet 128bytes, high speed access, point-to-point point-to-multipoint)
Wireless Data Communication	9.6kbps	low	medium	Two-way	limit	Packet switched, Service for data. Mobitex: Open protocol and hierarchical structure DataTAC: Open protocol and LAN structure.
FM	FM 100-3800bps	low	low	One-way	short to medium range	radius 46-77km
Beacon	1Mbps	high	low	Two-way	small area around beacon	DSRC
Cellular Telephone	9.6kbps CDPD 19.2kbps	low	medium	Two-way	limit (city area)	Cellular phone can be used for voice and data. CDPD will be popular in logistics business. CDPD is used for only data communication.
PCS	at least 8kbps	low	medium	Two-way	limit (city area)	digital voice and messaging service
GEOS LEO	GEOS, 21.33 kbps, Big LEO 2.4kbps, Little LEO 2.4-4.8kbps	high	high	Two-way	wide area	service for wide area communication.

Trunked Radio System (TRS)
Global System for Mobile Telecommunication (GSM)
Global Packet Radio System (GPRS)
Personal Communication System (PCS)
Geostationary satellite (GEOS)
Low Earth Orbiting Satellites (LEO)
Enhanced Specialized Mobile Radio (ESMR)
Dedicated Short Range Communication (DSRC)

Cellular Digital Packet Data (CDPD)

DRGS: local DRGS, broadcast-type DRGS, interactive DRGS, and mixed DRGS (2, 5, 10).

The local DRGS can use any type of communication media. The traffic center collect information and send that to cars. The in-vehicle unit decides the optimal path based on the information. However, the in-vehicle equipment is relatively expensive. The local DRGS has the advantage that the driver can select a personally preferable route and it is effective method while the level of diffusion of in-vehicle units is still low. However, if each vehicle individually selects its own optimum route, there is the likelihood the vehicles which have the same origin-destination may select the same route. In the future, when in-vehicle units are more common, there is the risk that the vehicles will become concentrated on empty routes, causing congestion.

In broadcast-type DRGS, the center determines the optimum route to various points based on collected information and provides these routes regardless of the destination of a particular vehicle by a FM subcarrier using radio frequency as shown in Figure 1.

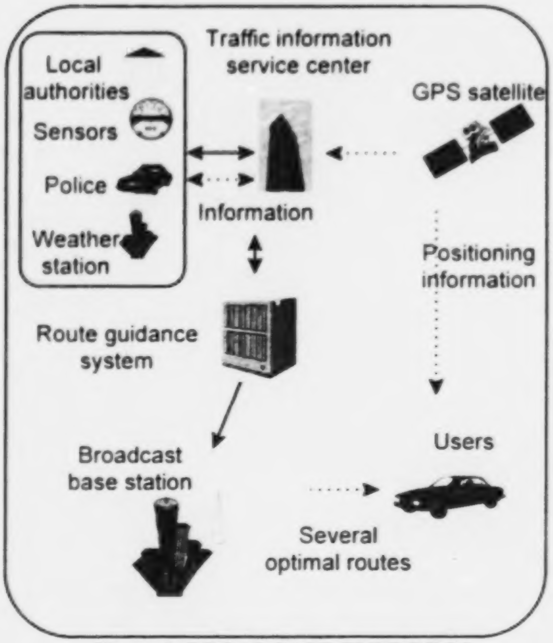
Local authorities
Sensors
Police
Weather station
Traffic information service center
GPS satellite
Information
Positioning information
Route guidance system
Broadcast base station
Users
Several optimal routes

Figure 1. BROADCAST-TYPE DRGS

The vehicle then selects a suitable route to its destination from several optimal paths received from center. Each car decides its own optimal path. This system does not require a high performance telecommunication media. Thus, it is economical for the reasons that existing telecommunication facilities can be used and in-vehicle equipment is relatively cheap. However, since it is the vehicle which must select the route, it has the same disadvantage as local DRGS mentioned above.

There are two kinds of interactive DRGS. One of them is interactive DRGS using beacon as shown in Figure 2. The other one is interactive DRGS using satellites as shown in Figure 3. Therefore, it can assign vehicles along road networks according to traffic conditions and so has the potential in the future to contribute to easing of traffic congestion. On the other hand, the beacons must have high performance in order to provide route information to in-vehicle units. The ultimate aim of this system is system optimization, but until in-vehicle units become popular enough, it will provide the optimum routes to vehicles individually. In the case of beacon, the beacon is used for telecommunication media and location of cars within limited small area. Although the installation cost of beacons is very expensive, in-vehicle equipment is not. In the case of satellites, in-vehicle equipment is relatively expensive. The maintenance cost of satellites is also expensive because the life expectation of a satellite is about 5-10 years and it must be replaced.

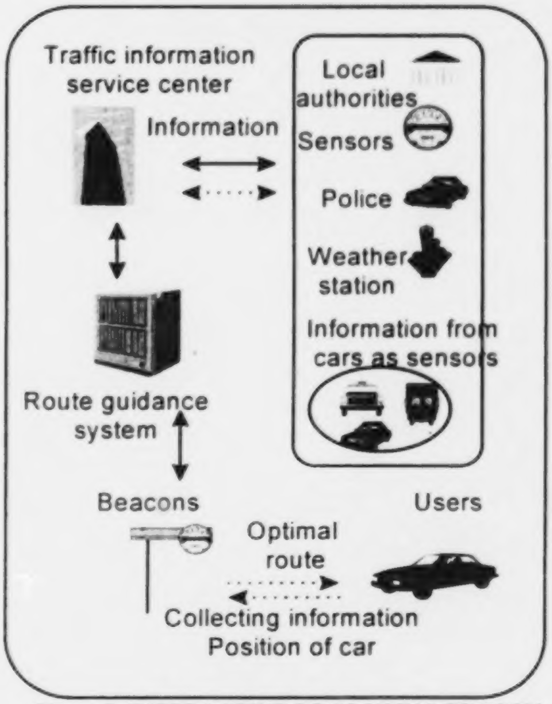
Traffic information service center
Information
Local authorities
Sensors
Police
Weather station
Information from cars as sensors
Route guidance system
Beacons
Users
Optimal route
Collecting information
Position of car

Figure 2. INTERACTIVE DRGS USING BEACON

Mixed DRGS can provide convenient route guidance by skillfully combining information provided by the interactive DRGS with the local DRGS function provided by the in-vehicle units. Local DRGS can select a route from the road network including local streets using only the in-vehicle database and if it has travel time information which is provided by the center, it can take this into consideration when selecting a route. However, it cannot select a route based on predicted conditions. On the other hand, the interactive DRGS does not include regional roads or local streets which have little traffic. It handles major roads which are covered by the traffic control systems. Therefore, route guidance by the interactive DRGS is suitable for long-distance routes, while local DRGS is more suitable for short-distance routes of few kilometers.

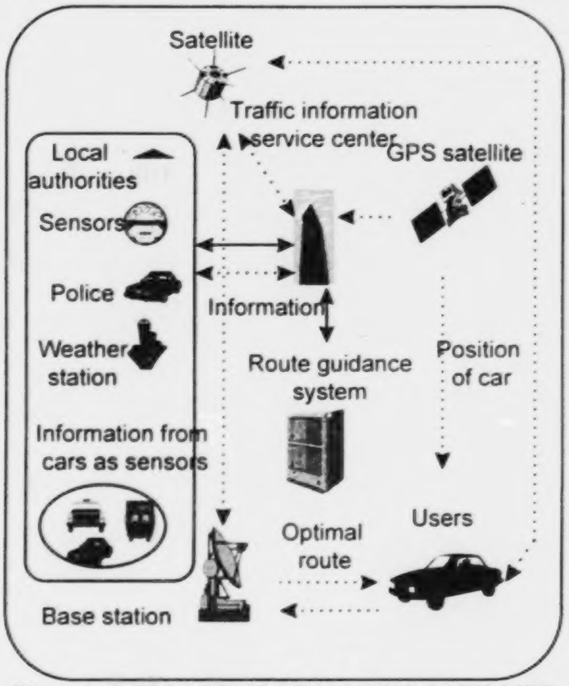

Figure 3. INTERACTIVE DRGS USING SATELLITE

5. Strategy of ITS in Korea

The selection of telecommunication media and DRGS are described in Sections 5.1 and 5.2. The system configuration of an ITS is explained in Section 5.3.

5.1 Selection of telecommunication media

We have some idea on how to select the best telecommunication media for Korean ITS business. First, FM subcarrier and cellular phone can be used to provide real time traffic and roadway conditions in the first stage of ITS, since existing broadcast base stations or cellular network facilities can be used. Since cellular phone uses existing telephone networks, travelers can check the traffic condition by telephone prior to departure from home or office. Even on their way to the destination, they can obtain the updated traffic information real-time with a mobile telephone while in their car.

Second, it is expected that cellular radio network or satellites will be used for communication when these systems are available and reliable and many people need to use these systems. The cellular phone currently cover most urban areas and look like the most promising prospect for mobile offices in Korea, but the data exchange costs will need to be considered as a significantly negative factor for the users of ITS.

Third, urban areas with well-developed highways can support beacon networks using DSRC relatively cheaply : they can be connected to their longitudinal cables and powered by the main supplies readily at all traffic signals and street lighting posts.

Fourth, the packet-switched network is more suitable for ITS than circuit-switched network because small data volumes of 10 to 200 bytes usually occur in road traffic application. The data stream is separated into shorter units called packets in packet-switched data network. The circuit-switched network offers point-to-point connection and is better suited for handling large data volumes (e.g. file transfer). Traffic messages can be sent to the in-car equipment using one of the defined data channels of circuit-switched network to update the dynamic navigation systems periodically or on demand, but in this mode every car equipment must be individually dialed.

Finally, one telecommunications medium will not be enough. We need to implement technically versatile and interoperable network options that are comprehensive and competitive, and encourage the development of low-cost future applications.

5.2. Selection of DRGS

Based on our discussion on DRGS in Section 4, we have several ideas selecting a suitable DRGS for Korean ITS business. DRGS is the major key function of ATIS. Upon calculating the optimum traffic allocation as a measure to achieve policy objectives, through information bulletin boards, traffic signals, and in-vehicle unit an unspecified number of automobiles are given recommended routes and directions for proceeding. For this purpose, the route guidance must be processed by centrally interactive DRGS center in Korea.

Considering the infrastructure, different types of in-vehicle units will be clearly distinguished. It may take several years to popularize these systems. It may be difficult to grasp both the origin and the destination and also to predict the traffic flow satisfactorily. As the rate of popularization of high level service in-vehicle units using interactive DRGS grows, traffic allocation and guidance routes compatible with traffic management policy may be calculated more effectively. It is necessary to examine guidance algorithms if they correspond with the rate of popularization of in-vehicle units. The accuracy of guidance routing calculation by this system at an earlier stage may not be much different from that of a stand-alone in-vehicle unit using local DRGS. Therefore, drivers may not find any advantage to the system and the popularization of high level service in-vehicle unit will be delayed. Therefore, for the propagation of high level service, attractive services need to be offered.

5.3. System configuration of ITS

The Korean ITS master plan focused on the use of cellular radio as the main carrier of traffic information and GPS satellites for positioning and navigation of cars. The functionality of a system based on the master plan was demonstrated at test site. Particular attention was given to the use of duplex communications.

This system investigated the application of cellular radio to improve road traffic informatics. All information is processed by a regional traffic information center. Along with historical data, the gathered data are used for traffic modeling. The traffic is predicted for the next few hours. Based on the prediction, suitable messages are generated to inform the in-car navigation system of relevant traffic incidents and to control the traffic to avoid the development of congestion.

The Korean ITS (especially, ATIS and CVO at present) is a system utilizing wireless communication network; scheduled deployment for commercial use in the spring of 1998. In order to increase cost effectiveness and efficiency, the service will be launched first in major metropolitan areas where there is a greater need (e.g., due to chronic traffic congestion). Then the service will include other service areas as facilities. This system may be designed to provide real-time traffic information to drivers by three communication media: wireless data network, cellular phone network and wide-area FM multiplex broadcast.

As shown in Figure 4, the Korean traffic information system processes its information in four stages: First, the traffic information is collected from the police headquarters and Korean road traffic information committee is collected according to the specific administrative objectives of each source. Second, Integrated Logistics Information Network System (ILINS) makes raw data from information sources classify and process for users. Third, ILINS distributes and transmits the information to users within acceptable range of cost. The wireless data communication network, FM subcarrier, and GPS satellites are supposed to be used in Korea. Fourth, ILINS makes the usage of information be used for promoting the safe, smooth flow of traffic for users. To achieve this goal, it will be necessary to get as many drivers as possible to begin using the system as quickly as possible. It is also encouraged for manufacturer to develop cheap and different kinds of information reception devices.

6. Conclusion

The wireless telecommunications technology and various DRGS for ITS are introduced in this paper. It is implemented to make the structure of communication infrastructure and DRGS in Korea.

FM broadcast type media using radio frequency or cellular phone is used for communication media providing real time traffic and roadway condition and the broadcast type DRGS is supposed to be used in the first stage of route guidance in Korea. It is expected that trunked radio system (TRS), wireless communication, beacon using DSRC, and satellites are used for communication and the GPS satellites are used for positioning and navigation of cars when mobile communication environments are available and reliable.

Interactive DRGS using beacon, cellular radio network or satellites will be used when mobile telecommunication infrastructure is stable to collect much more correct information and when there are many users. The mixed DRGS using combinations of local DRGS and interactive DRGS are also considered to be adapted.

We will strategically pursue the Korean ITS based on the following criteria: feasibility of ITS basic objective, combination of public and private enterprise, marketability, making realization, reception of advanced technology, and equally developing different area.

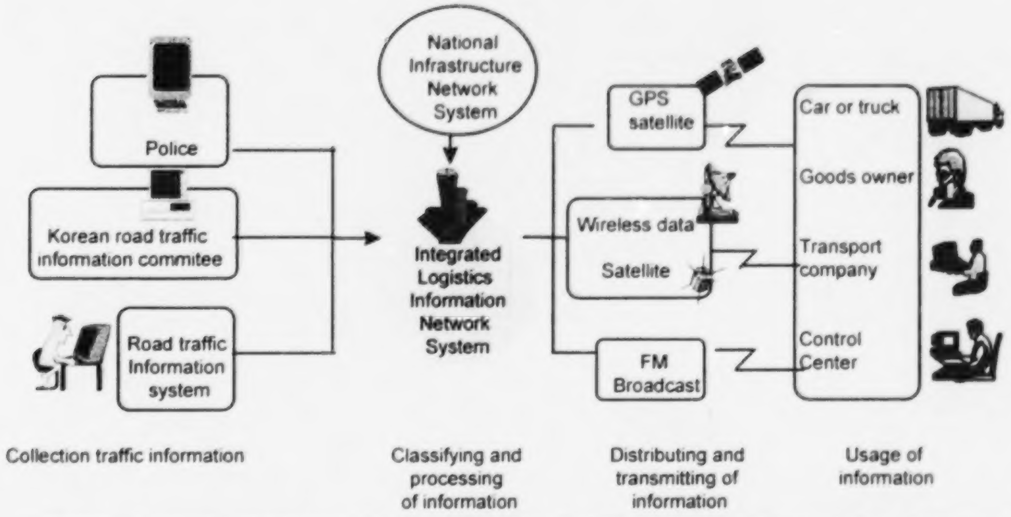
Police
Korean road traffic information commitee
Road traffic Information system
National Infrastructure Network System
Integrated Logistics Information Network System
GPS satellite
Wireless data
Satellite
FM Broadcast
Car or truck
Goods owner
Transport company
Control Center
Collection traffic information
Classifying and processing of information
Distributing and transmitting of information
Usage of information

Figure 4. THE CONFIGURATION OF KOREAN TRAFFIC INFORMATION SYSTEM

Reference

1. Arnold, James A., "Rural versus urban a communication infrastructure perspective", Proceedings of the 1996 Annual Meeting of ITS AMERICA 6th, Vol. 2, Houston, Texas, April, 1996, pp.1045-1051.
2. Atsushi Kawami, Hironao Kawashima, Toshihiko Oda, and Taka Sugiura, "The analysis for dynamic route guidance system considering the influences of intersections on ordinary road network", The 3rd Annual World Congress on ITS at Orlando, Florida, October, 1996.
3. Elliott, Scott D. and Dailey, Daniel J., "Wireless communications for intelligent transportation systems", 1995, Artech House, Inc.
4. Schulz, Wolfgang, "Traffic management improvement by integrating modern communication systems", IEEE Communications Magazine, October 1996, pp.56-60.
5. UTMS Japan, "Establishing the Universal Traffic Management Society of Japan", UTMS news, Issue 1, November 1993, pp.1-8.
6. UTMS Japan, "Special issue for the third annual world congress on ITS '96 Orlando", UTMS news, Issue 5, October 1996, pp.1-8.
7. Vijay M. Patel and Carl W. Kain, "Deployment of ITS/DSRC Application: Status, Issues, and Options", Paper for the World Congress, 1996.
8. Wingfield, Paul A., Atkins, WS, "Telecommunications Media for Transport Telematics", IEEE Communications Magazine, October 1996, pp.62-67.
9. Yamada, Shinsaku, "The stategy and deployment plan for VICS", IEEE Communications Magazine, October 1996, pp.94-97.
10. Yoshimi Tanaka and Kouhei Takeuchi, "Dynamic route guidance systems and public transportation priority systems in UTMS", Proceedings of the annual meeting of ITS America 6th, Vol. 1, 1996, pp.18-24.
11. Korean Construction & Transportation Bureau and Police Bureau, "Intelligent Transport System Master Plan", 1996, July

Call Origination and Termination Strategies for Mobile Satellite Systems

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1. ABSTRACT

To achieve the global ubiquity promised, Mobile Satellite Service ("MSS") carriers will need to resolve many terrestrial issues including: a user friendly dialing regime that integrates MSS networks into the existing direct distance dialing system, transborder use of transceivers, and low cost interconnection of gateway facilites with the public switched telephoe network. This paper will examine call origination/termination strategies of several representative MSS operators with an eye toward identifying exposure to unanticipated expenses, particularly that imposed by the accounting rate settlements process used by carriers to divide international toll revenues. The paper concludes that users must have unlimited opportunities to use their MSS telephones across political boundaries, dialing must work seamlessly with the preexisting numbering system and MSS operators will have to confront the financial impact of the accounting rate regime.

2. Introduction

Mobile Satellite Service ("MSS") ventures like Iridium,[1] Globalstar [2] and ICO, Ltd. [3] have triggered substantial interest and scrutiny. However, little attention has focused on terrestrial network integration functions, i.e., how MSS operators will secure seamless linkage between their satellite constellations and earthbound call originators and recipients. To deliver the much touted ubiquitous access, MSS carriers have to confront and resolve three major issues:

1) whether nations will grant licenses and operational authority so that users can originate calls using terminals acquired, possibly without a license, in another country;

2) how to reach establish a user-friendly dialing regime that integrates MSS networks into the existing International Direct Dialing ("IDD") system; and

3) what worldwide configuration of gateway earth stations will reduce traffic routing costs without triggering expensive cross-border toll revenue division obligations.

This paper will examine call origination and termination strategies of several representative MSS operators with an eye toward considering how best to integrate MSS operations with conventional international message telephone services ("IMTS") in a user friendly way and at the lowest cost to MSS operators. The paper concludes that MSS operators will benefit from a growing consensus reached under the auspices of the International Telecommunication Union ("ITU") to provide a shared country code for IDD access to MSS networks and to promote cross-border use of MSS transceivers. On the other hand, the paper concludes that MSS operators have located their gateways primarily to satisfy technical requirements of the satellite constellation, or as financial inducements for investment in their ventures. Accordingly, if the current accounting rate settlement process used by carriers to divide international toll revenues applies to new MSS ventures, then long and costly terrestrial links to and from gateways may impose substantially and not fully anticipated costs.

2.1 MSS Basics

Technological innovations in mobile communications have evolved to the point where one can envision ubiquitous communication network access provided via handheld terminals:

> The increasing availability of mobile communications over the past decade is freeing business and residential consumers from the physical constraints of a wholly wired telecommunications network. . .. The revolution in mobile and portable technologies has continued unabated in the decade since cellular first was authorized. Significant technological advances have expanded substantially the number and types of wireless telecommunications services that can be made available to the American people. [4]

Satellite footprints, even from fast moving space stations in low earth orbit, provide a near immediately available infrastructure serving remote villagers and peripatetic "road warriors" alike. Despite substantial upfront costs ranging into the billions of dollars, these ventures need only secure single digit penetration in each market segment to succeed. However, the MSS system architecture is costly, complex and requires most of the budget to be expended before the first minute of revenue generating traffic occurs.

MSS networks require the construction, launch and management of a constellation of numerous satellites capable of providing "service links" to receive traffic from handheld transceivers. The satellites also must process "feeder link" traffic generated from earth stations, also known as "gateways," interconnected with the Public Switched Telephone Network ("PSTN") so that subscribers of the wireline telephone network can originate and receive MSS calls. Typically service and feeder links operate over different frequency bands, and some MSS constellations use a third allocation to provide "inter-satellite links," i.e., transmission of traffic from one satellite to another onward toward a satellite overhead the gateway situated closest to the intended call recipient.

The number of required gateways in a MSS network largely depends on whether the satellite constellation uses inter-satellite links. As large distances may separate caller and call recipient, MSS operators have two basic options:

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1) install many gateways for earth-based processing of traffic and routing to the gateway closest to the call recipient (Globalstar has opted for this option); or

2) use inter-satellite links for space-based processing of traffic and routing to a smaller number of gateways (Iridium has opted for this option).

Having numerous gateways reduces complexity and cost in satellite manufacture, but increases earth station expenses and costs incurred in switching and routing traffic among multiple gateways. Using inter-satellite links increases satellite cost and complexity, but reduces the ground-based investment as multiple satellites can route the traffic to fewer, geographically dispersed earth stations. In either scenario, the network also must include data processing and intelligent peripherals capable of:

- identifying and locating call originators;
- determining their credit worthiness and whether they have authority to originate calls from their current location;
- originating and terminating MSS via conventional domestic and international switched telephony networks; and
- billing calls and updating data bases that provide registration information about subscribers.

3. Four Types of MSS Satellite Ventures

3.1 Incumbent Geostationary Orbiting Satellite Cooperatives

The traditional model for telecommunications via satellite involves space stations in geostationary orbit ("GSO") 22,300 miles above earth transmitting very large footprints that can illuminate more than one third of the earth's surface. These satellites primarily provide point-to-multipoint services, like video program delivery, with some point-to-point applications, like telephone service, particularly for sparse routes, locales well inland from where undersea cables make their landfall and mobile applications.

The International Mobile Satellite Organization ("Inmarsat") [5] operates GSO satellites for maritime, aeronautical and land mobile services. It operates as a cooperative combining commercial goals with a universal service mission that promotes cost averaging among dense and sparse routes, and affirmative efforts to recruit participation by developing nations. Given this mission Inmarsat has secured from national governments a special status with privileges and immunities that, for example, exempt the organization from tax liability.

The traditional GSO satellite model has undergone some revision with the onset of private MSS ventures like the American Mobile Satellite Corporation ("AMSC") who lack the cooperative structure and mission. In response, Inmarsat seeks to privatize, despite having already spun-off ICO Communications, a commercial MSS venture. [6]

3.2 New Satellite Orbits and Operators

Three new satellite system models have evolved:

1) "Little" LEOs, a constellation of very small and relatively inexpensive satellites operating on Very High and Ultra High frequencies and providing non-voice, data and position location services. Ventures in this model include Orbcomm and VitaSat;

2) "Big" LEOs, a constellation of more numerous, complex, and expensive satellites operating in the L-band (1.5-2.5 GigaHertz) and providing voice, data and position location services to fixed and mobile users. Ventures in this model include Iridium, Globalstar ICO, and Odyssey, a venture organized by TRW and Teleglobe of Canada; and

3) "Broadband Overlay Satellites," a constellation of LEO or GSO satellites operating in the Ka-band (20-30 GHz) to create a seamless web capable of providing wideband capacity primarily to fixed users. Ventures in this model include Spaceway/Expressway, [7] Teledesic,[8] Cyberstar, [9] Astrolink [10] and Celestri. [11]

Because LEO satellites will operate in orbits much closer to earth, they can communicate with handheld transceivers instead of the somewhat larger (2 kilogram) terminals now needed to communicate to GSO space stations. However, the closer proximity to earth reduces the size of the satellite footprint and also eliminates synchronization with earth meaning that the satellites speed across a particular location on earth from one horizon to the other in a matter of minutes.

LEO satellite networks will require a constellation of space stations to provide global coverage. Because the satellites move quickly over any single point on earth, the operator must find a way to hand off traffic from one satellite to the other, or build such intelligence into the way earth stations track and manage the flow of traffic. In either scenario, LEO satellites present a moving target thereby requiring greater network management functionality than needed for GSO satellite systems.

Consider LEO system architecture as the opposite of wireless mobile systems like cellular radio. For terrestrial systems, mobility lies with the user who must be tracked using fixed transmitters on towers. With LEO systems the key mobility factor lies in the speeding satellites rendering user movement comparatively insignificant.

3.3 Terrestrial Risk Issues

Much of the MSS risk assessment has involved conventional cost and market analysis coupled with an examination of the technological challenges presented by erecting, launching and managing a large "constellation" of satellites.

MSS entrepreneurs have presented business cases demonstrating that their ventures will become profitable during the lifetime of the first satellite generation based on traffic projections, estimates on user average minutes of use ("MOU"), cost to launch and operate the satellites and end user charges of between $1.00 and $1.45 per MOU, plus a monthly access fee of $25-45 for AMSC and $1.75 per MOU, plus all domestic termination costs for Iridium voice services. [12] Globalstar has announced a wholesale space segment charge of between $0.35 and $0.53. [13]

Assuming that a robust market exists for MSS even with a $3.00 per minute charge and that the operators can resolve all technological challenges, other risk factors bear consideration.

3.31 Transborder Roaming

Subscribers of MSS will expect to use their transceivers across international borders. However, transborder cellular roaming has proven difficult and costly, with some nations balking at the prospect of allowing use of transceivers licensed in another country, or possibly not licensed at all. The ITU has organized conferences to consider ways for nations to recognize the licensing or authorization granted by another nation. [14] Absent such a mechanism for multilateral coordination, users may not be able to operate their MSS transceivers in some countries, or they may experience inconvenience, customs and immigration problems, and delays in border crossings that can reduce traffic volumes and the perceived value of MSS.

Satellites provide telecommunication functionality where wireline and other terrestrial options are economically infeasible, or technologically inferior. Satellites will continue to provide cost-effective service solutions. Whether they provide additional services to a larger number of user groups in geographically diverse locales depends on the breadth and scope of terrestrial options. If the concept of "plain old telephone service" expands though infrastructure development initiatives, and if mobility, ubiquity, bandwidth on demand and other concepts stimulate market development, then satellites will become an even more significant factor by complementing terrestrial opotions and by filling in gaps created by inadequate or non-existant terrestrial options.

In support of the view that MSS will play an increasingly significant role in the global telecommunication infrastructure a study group operating under the auspices of the ITU has proposed an amendment to the Telecommunication Standardization Sector Recommendation E.164 to allow for the shared use by MSS operators of the 881 country code with an additional digit identifier to access a specific carrier. [15] Seamless integration of MSS networks into the existing international dialing regime will help promote user friendly, ubiquitous MSS. Additionally many nations have supported a Memorandum of Understanding facilitating the right of MSS users to operate handsets across national borders. [16]

To facilitate PSTN access, MSS organizers need a globally dispersed set of partners, and probably would prefer that they have clout with their governments, or better yet, that they possess a monopoly telecommunications franchise. From the perspective of resolving terrestrial network access issues, the ideal set of investors would have been Public Telecommunications Organizations administrations, or the government franchised INTELSAT/Inmarsat carriers as these enterprises have the expertise, access to markets, possibly exclusive current satellite franchises, clout with government and the potential to thwart market access and competition. For the most part ventures, other than ICO have not established many alliances with incumbent satellite operators and PTOs. Instead they have secured investment primarily from manufacturers, recent market entrants in wireless terrestrial telecommunication markets, investment groups, and launch providers. Accordingly, access to markets, licenses and authorizations and the opportunity to compete with incumbents may be delayed, rendered more costly, or denied in some nations.

3.32 Gateways: The Weak Link in MSS

MSS operators need to fashion a workable technical and financial plan for integrating their gateway earth stations with the conventional public switched telephone networks throughout the world. The terms and conditions of such access must not upset MSS operators' business cases, including the ability to offer a complete retail service at less than $3.00 a minute. In sustaining this figure MSS operators must convince PSTN operators that MSS traffic will not siphon off traffic existing revenue streams through bypassing conventional toll revenue division agreements.

MSS operators assume that domestic tail circuits from and to international gateway facilities will not present a major financial burden. Iridium initially included a $0.90 rate element in its end user $3.00 per minute charge to cover gateway expenses, compensation to national carriers for permitting calls to originate and terminate and domestic tail circuits. Subsequently it revised its business plan to factor in greater than anticipated geographical penetration by terrestrial cellular radio services and apparently to shift the accounting rate cost risk totally onto users. Iridium now proposes to offer a $1.75 per minute space segment charge supplemented by a recurring $50 monthly usage charge and all long distance charges from gateways to call recipients.[17] In the United States, an access charge regime exists in which MSS operators would qualify[18] to receive and have terminated traffic over inter-exchange and local exchange carrier facilities at no more than 10-15 cents a minute for interstate service, with very long or intrastate routes ranging up to 20-30 cents a minute.

In other nations the routing of traffic to and from a gateway via switched facilities may cost substantially more. If MSS operators have to route traffic as if it were conventional IMTS, retail charges can range up to several dollars, particularly if the routing carriers apply established international toll revenue division agreements, known as the accounting rate settlement process. MSS operators may have assumed that gateway operators can secure agreements with non-investing national carriers to exempt gateway traffic from application of conventional high IMTS and accounting rates. On high volume routes, private line routings should solve the problem. However, less dense routes may not generate enough traffic to load a private line efficiently, thereby resulting in the use of conventional switched lines, customarily subject to accounting rate settlements. In either scenario, routing traffic exempt from an accounting rate settlement may trigger claims that MSS operators have reneged on their promise not to bypass incumbent carriers' networks.

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3.4 Accounting Rate Basics

Until recent market liberalization decisions by national legislatures and regulatory agencies, a single facilities-based international telecommunication carrier typically negotiated an "operating agreement" with other national monopolists to arrange for the interconnection of lines, and the division of toll revenues for calls between nations. This arrangement provided for a correspondent relationship between a select and limited set of players for routing calls. The carriers' operating agreements included an "accounting rate" ostensibly identifying the approximate per minute costs the carriers would incur to link two international "half-circuits"[19] and for the two domestic "tail" circuits running to and from international gateway facilities.[20] For routings involving two carriers, [21] the correspondents typically would agree to a 50/50 "settlement rate" whereby the carriers would divide equally the accounting rate based on the view that they equally participated in routing the call. [22]

The accounting rate regime has increasingly generated anger and contempt among those carriers and users who incur higher than necessary costs as a result of the use of accounting rates as an accepted proxy for carrier costs and in turn a price floor below which carriers are disinclined to price retail services. The failure of carriers to negotiate lower accounting rates and commensurately higher end user charges[23] runs counter to substantial cost reductions accruing from technological innovations and economies of scale. [24]

While retail charges for domestic and international services significantly differ, the FCC recently determined that actual cost of service differences are "no more than a few cents." [25] In a Report and Order released in August, 1997 the FCC yet again finetuned its accounting rate policy by revising its settlement rate benchmarking system that prescribes a average cost settlement rate [26] (one-half of an imputed accounting rate) that U.S. licensed carriers must strive to negotiate with their foreign correspondents on a timely basis. The Commission calculated lower benchmark rates, but established a generally longer transition time based on national income with an even longer transition for nations with fewer than one telephone line per one hundred inhabitants. It created different benchmarks and a variable timetable for reaching them based on a nation's level of economic development, as defined and classified by the World Bank and the ITU.

The four levels of economic development under this classification scheme are: (1) low income, GNP per capita of less than $726; (2) lower-middle income, $726-$2,895 per capita; (3) upper-middle income, $2,896-$8,955 per capita; and (4) high income, $8,956 or more. [27] For upper income countries the FCC set a 15 cents per minute settlement rate benchmark, down from a 1996 "upper end" rate of $0.154 rate and a calculated range of 9 to 22 cents per minute. For both upper middle income countries and lower middle income countries the Commission set a 19 cents per minute settlement rate benchmark, slightly down from the Commission's previous benchmark of $0.191 and a 12 to 26 cent range. For lower income countries the FCC set 23 cents per minute rate, slightly down from the Commission's previous $0.234 benchmark and range of 13 to 33 cents.

The adopted transition schedule gives U.S.-licensed carriers operating on routes to upper income countries one year from the effective date of the Commission's Order (until January 1, 1999) to reach the applicable benchmark rate. The carriers have two years,

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or until January 1, 2000, to negotiate accounting rates at or below the benchmark with upper middle income countries, and until January 1, 2001 to reach the same benchmark with lower middle income countries. They have until January 1, 2002 to reach the benchmark with low income countries, and an additional year, until January 1, 2003, to do so with countries with telephone line penetration ("teledensity") of less than one per one hundred inhabitants.

3.41 The Accounting Rate Challenge

MSS operators must address the consequences of having traffic subject to the accounting rate regime when traffic to and from a gateway traverses international borders.[28] For its part the FCC has signalled a willingness to support preferential or different treatment of MSS traffic. The Commission exempted MSS traffic from its International Settlements Policy[29] that requires equal division of accounting rates, equal treatment of all U.S. carriers and proportionate return of inbound U.S. traffic.

However, it remains to be seen whether and how over one hundred national governments will address the issue, particularly in countries where the incumbent international or domestic carrier has:

- not invested in any MSS venture;
- invested in one MSS venture and desires to help its partner capture a monopoly or dominant market share;
- expressed concerns about the potential for bypass of preexisting routing arrangements and revenue streams; or
- not participated in, or has not endorsed the consensus reached at ITU-sponsored meetings designed to promote Global Mobile Personal Communications by satellite.

Heretofore MSS operators have gone on record with summary conclusions that terrestrial network integration will present no problem.[30] However, they appear not to have vigorously addressed this matter in view of immediate concerns like satellite construction and finance. MSS operators appear to have assumed that a consensus will be reached under the auspices of the ITU,[31] or that investors and gateway operators can negotiate routing agreements on favorable terms. ITU documents recognize the complexity in MSS-PSTN integration, but no concrete plan or consensus view has evolved.[32]

3.5 The Worst Case Scenario: Space Segment + Gateway Charge + Accounting Rate

Absent an exemption for traffic injected into IMTS traffic streams, having sufficient traffic to route traffic via private lines or operating a gateway in every country, MSS operators may find gateway-to-call recipient charges well exceeding the rate earmarked for that portion of the overall route. The worst case MSS pricing scenario would entail a summation of space segment (ranging from approximately $0.35 for Globalstar to$1.75 for Iridium) plus payments to the terminating gateway operator (assume $0.10) plus the applicable IMTS international accounting rate from the gateway country to the country of the call recipient (as much as $3.00 for some routes).[33] Despite some downward trajectory in international accounting rates, many routes still require more than what MSS organizers may have assumed their gateway operators would have to pay for routing traffic to relatively nearby, but cross-border destinations, e.g., U.S.-Guyana: $1.70; U.S.-Honduras or Panama,$1.20; U.S.-Mexico $0.70 [34] and United Kingdom-Armenia: $2.00; U.K.-Moldova: 0.714 SDR ($1.10); U.K.-Belarus: 0.483 SDR ($0.74); U.K-Spain: 0.422 SDR ($0.65); U.K.-Portugal 0.415 SDR($0.64). [35]

4. Conclusion

MSS operators largely owe the spectrum allocation success achieved at the ITU on representations that the networks will not bypass incumbent carrier facilities, or otherwise reduce existing revenue streams. Traffic carried by MSS operators in large part should generate a new revenue stream rather than cannibalize existing ones. However, accounting rate avoidance strategies might generate opposition even if the use of a special MSS country code for dialing and other automatic number identification technologies could make it possible to distinguish MSS traffic from "conventional" IMTS traffic. Because MSS gateway operators probably will route traffic into IMTS trunks, MSS traffic will be commingled with "conventional" IMTS traffic and carriers in the call recipient's country probably will insist that the applicable international accounting rate apply to all such traffic.

If application of an accounting rate proves inevitable, MSS operators having chosen to deploy a comparatively larger number of gateways may accrue a competitive advantage. With MSS architecture plans well along and given the significant expense in constructing gateways, construction costs, the second best alternative lies with installing gateways exclusively in countries with low accounting rates overall, or where the most likely call terminations will trigger the lowest possible accounting rates compared to adjacent nations. [36]

However, it appears that MSS operators have consider neither option in their gateway siting plans. Gateway franchises constitute a major argaining chit an MSS organizer can use to enhance the financial attractiveness of a venture as gateway operators accrue revenues from systemwide space segment utilization and for every call traversing their gateway facilities. Accordingly, the prospective investor seeks a large exclusive gateway service area to maximize traffic streams and financial returns. The gateway investor may concentrate on geographical scope of service exclusivity, and may not have considered the potential for high accounting rate settlements and perhaps the belated recognition that additional gateways may be necessary to abate the consequences of long and costly tail circuits. [37]

MSS operators may come to find terrestrial call management and logistics pose challenges no less daunting than constructing, launching and managing a large constellation of satellites. MSS organizers and their investors will need to devote as much time on ground-based issues as they have devoted to their future satellite constellations.

NOTES

1. Iridium will operate a $5 billion global constellation of 66 LEO satellites, about 400 miles above earth, able to provide voice, data facsimile and position determination services to handheld transceivers. Motorola created the Iridium concept and has spent almost five years and several hundred million dollars developing the technology and soliciting investors to form a global consortium. In 1993 an initial Private Placement of $700 million created a consortium comprised of a geographically diverse set of investors representing different aspects of space, telecommunications and venture capital industries: Khrunichev Enterprise, builder of the Russian Proton launch vehicle, China's Great Wall Industry Corp., operator of the Long March launch vehicle, Iridium Nippon, a Japanese investment group led by Daini Denden, a major cellular radio operator and Kyocera Corp., a diversified manufacturer, two venture capital groups, Mawarid Group of Saudi Arabia and Muidiri Investments BVI, Ltd. of Venezuela, incumbent carriers, BCE, Inc. of Canada, Sprint of the U.S. and STET of Italy, manufacturers of Iridium network equipment, Lockheed and Raytheon, and telecommunication enterprises in developing nations, including United Communications Industry of Thailand. In 1997 the venture raised $223 million through initial public offering of Iridium World Communications and sold S. Pacific gateway rights for $100 million. Total assets and investment totaled $2.9 billion.

2. Globalstar plans on operating a LEO constellation of 48 satellites in 8 orbital planes. With fewer satellites operating in orbits about 800 miles above earth, the $2.5 billion Globalstar network is projected to provide service at a cost of less than $0.50 a minute plus a monthly service charge of $60-70. However, less in-orbit resources means that the network will rely heavily on the widespread availability of gateway earth stations to route calls.

Globalstar initially was organized by Loral/Space Systems, a satellite manufacturer and Qualcomm, Inc. an innovator in code division multiple access mobile radio technology and provider of vehicle location services via GSO satellites. In 1994, the venture announced that it had secured the infusion of several hundred million dollars from new investors including, Alcatel, a major French aerospace and telecommunication equipment manufacturer, France Telecom, the country's monopoly telecommunication carrier, Alenia, an Italian aerospace manufacturer, Deutsche Aerospace and DASA, aerospace manufacturers in Germany, Hundai, a major diversified Korean manufacturer, Dacom, Korea's second telecommunication carrier, Air Touch, the cellular radio spin-off of Pacific Telesis and Vodaphone, a British cellular radio operator.

3. ICO Global Communications was spun-off from the Inmarsat global cooperative in January 1995. It operates as a private company and plans on providing personal mobile global communications services in the year 2000. The venture has raised over $1.5 billion from 47 investors from 44 countries. The investors include many Inmarsat signatories, but also telecommunications and technology companies like Hughes Communications. The ICO space segment will comprise ten operational satellites and two in-orbit spares operating in middle earth orbit. The first launch is scheduled for 1998.

4. Amendment of the Commission's Rules to Establish New Personal Communications Services, GEN Docket No. 90-314, Notice of Proposed Rule Making and Tentative Decision, adding ET Docket No. 92-100 7 FCC Rcd. 5676, 5678 (1992).

5. See International Maritime Satellite Organization Convention, done at London September 3, 1976, entered into force July 16 1979, 31 U.S.T. 1, T.I.A.S. 9605.

6. See Rob Frieden, "Privatization of Satellite Cooperatives: Smothering a Golden Goose?" 36 Virginia Journal of International Law, No. 4 1001(Summer, 1996); Rob Frieden, "Should Intelsat and Inmarsat Privatize?" 18 Telecommunications Policy, No. 9, 679-686 (December, 1994).

7. Hughes Communications, Inc. submitted the Spaceway broadband Ka-band application to the FCC in December, 1993. The company anticipates a first launch in late 1999 culminating in an 11 satellite constellation. Initially the Spaceway network will provide coverage to approximately 90% of the world's population segmented into four overlapping regions each with two geostationary satellites. In 1997 Hughes proposed the $3.85 billion Expressway satellite network, the first commercial proposal to use the 40-50-GHz frequency band. The Expressway proposal calls for 10 orbital slots, with two satellites each. Hughes plans to launch the first Expressway satellite 50 months after FCC approval.

8. Rather than provide ubiquitous narrowband (less than 4800 bits per second) capacity to mobile users, Teledesic will offer a global overlay of wideband functionality using Ka-band frequencies (20-30 GHz). The system will offer throughput rates in excess of 2 Megabits per second initially from 288 refrigerator sized satellites at a total cost of $9 billion.

Like its visionary backers, which include Bill Gates and Craig McCaw, Teledesic pushes the envelop with an eye toward providing a ubiquitous, broadband Global Information Infrastructure. The system will commercialize a technology, developed as part of the Strategic Defense Initiative, that deploys observer ("Brilliant Eyes") and interrupter ("Brilliant Pebbles") satellites into a seamless, global array. In 1997 Boeing agreed to invest up to $100 million in the venture for a 10% share.

9. Loral Space and Communications Ltd. has proposed a comparatively modest three-satellite Ka-band system with an eye toward being the first to commence service in 1999. The company teamed up with Alcatel in 1997 to propose a $3.9 billion video and data venture called Sky Bridge, comprised of 64 LEO satellites.

10. Lockheed Martin Telecommunications has proposed a network of nine satellites operating from five orbital locations providing global coverage. The first satellite is scheduled for the first quarter of 2000 with complete deployment by 2001.

11. Motorola has proposed a $13 billion, Ka-band satellite network comprised of both geostationary and low earth orbiting satellite. Unveiled in June, 1997 the Celestri system will provide high-speed data and video transmissions to 99% of the globe beginning in 2002. The proposed system folds in parts of two previously-proposed Motorola satellite projects, Millennium and M-Star. The initial backbone of the system will be one GEO and 63 LEO satellites. While the LEO spacecraft would provide high-speed interactive communications around the globe, the GEO component would broadcast to users in a send-only mode. The total Celestri system will have capacity to transmit 80 gigabits per second.

12. Iridium initially proposed to offer a single, flat rate of $3.00 per MOU plus a monthly recurring cost of $50 for voice services. Variations in domestic termination costs and the possibility of having to pay a high settlement payment may have prompted the change in pricing strategy.

13. Douglas G. Dwyer, "Policy Challenges and Opportunities for Global Mobile Personal Communications by Satellite: The Globalstar Viewpoint," presented to the World Telecommunications Policy Forum (Geneva, 1996), available at http://www.itu.int/pforum/paper3-e.htm [hereinafter cited as Globalstar World Telecommunications Policy Forum Presentation].

14. See International Telecommunication Union, Informal Group--Memorandum of Understanding-GMPCS, Chairman's Report (Feb. 18, 1997) available at http://www.itu.int.pforum/ gmpcs-mou/report-e.htm; Memorandum of Understanding to Facilitate Arrangements for Global Mobile Personal Communications by Satellite, Including Regional Systems (Feb. 18, 1997) available at http://www.itu.int.pforum/gmpcs-mou/mou-e.htm.

15. See International Telecommunication Union, Telecommunication Standardization Sector, Study Group 2, COM 2-R53, Report of the Meeting of Study Group 2, Geneva, 14-24 May 1996-General Issues of Concern to the Study Group as a Whole, Sec. 11.2, Shared E.164 Country Code for GMSS Service Providers (June, 1996).

16. See International Telecommunication Union, Informal Group, Memorandum of Understanding to Facilitate Arrangements for Global Mobile Personal Communications by Satellite, Including Regional Systems (GMPCS-MoU) (Februaru 18, 1997); available at http://www.itu.ch/GMPCS/gmpcs-mou/final/mou-e.htm.

17. See Quentin Hardy, "Iridium Creates New Plan for Global Cellular Service," available at Wall Street Journal Interactive Edition, Company Briefing Book, Aug. 18 1997.

18. Access Charge Reform, Price Cap Performance Review for Local Exchange Carriers, Transport Rate Structure and Pricing and End User Common Line Charges, CC Docket Nos. 96-262, 94-1, 91-213, and 95-72, First Report and Order, FCC 97-158 (adopted May 7, 1997).

19. The half-circuit concept operates on the presumption that carrier correspondents achieve a "whole circuit" by linking two half-circuits at the theoretical midpoint of a submarine cable, or at the satellite providing the transmission link. In the submarine cable scenario, each carrier has responsibility to secure access to circuits linking transmission facilities on its territory to the location where the cable makes its landfall (referred to as the cablehead), possibly located in a different nation, and onward to the midpoint. For more background on international telecommunications operations and policy see Rob Frieden, International Telecommunications Handbook (Norwood, MA: Artech, 1996).

20. For a complete history of accounting rate regulation by the Federal Communications Commission, see Rob Frieden, "The Impact of Call-Back and Arbitrage on the Accounting Rate

Regime," 22 Telecommunications Policy, No. 1 (1997); Rob Frieden, "International Toll Revenue Division: Tackling the Inequities and Inefficiencies," 17 Telecommunications Policy No. 3, 221-233 (April, 1993); R. Frieden, "Accounting Rates: The Business of International Telecommunications and the Incentive to Cheat," 43 Federal Communications Law Journal No. 2 111-139 (April, 1991).

21. One or more additional carriers participate in calls requiring "transiting," the use of an intermediary carrier. For example a carrier in the United Kingdom might use transit facilities of a United States carrier to route calls destined for Hong Kong. For conventional International Message Telephone Service ("IMTS") traffic, a single transiting carrier would receive up to one-third of the applicable accounting rate, i.e., United Kingdom-Hong Kong in the above example.

22. The accounting rate system operates largely independent of the manner in which carriers invest in international satellites and submarine cable capacity. Carriers pool investments in satellite cooperatives like Inmarsat and submarine cable consortia. Such pooling should result in similar costs between nations using the same transmission facility, e.g., direct dialed international message telephone service between the United States and Sweden vis a vis calls between the United States and Finland. However, accounting rates may widely vary even for nearby or adjacent nations. In the above example, the United States-Sweden per conversation minute accounting rate is 0.12 Special Drawing Rights ("SDRs")($0.16 USD), but the United States-Finland accounting rate is 0.35 SDRs ($0.48). See United States Federal Communications Commission, International Bureau, Telecommunications Division, Policy and Facilities Branch, "Consolidated Accounting Rates of the United States (May 1, 1997), available at http://www.fcc.gov/ib/td/pf/consolar.xls (Excel file).

23. A variety of factors impact the retail "collection charges" imposed on end users by carriers. They include the scope of competition, degree of regulatory oversight of rates and the applicable accounting rate. Carriers do not want to price services below the accounting rate, but may have to do so out of competitive necessity. Under such a scenario the carrier expects to recoup outbound traffic loses with inbound traffic subject to the above-cost accounting rate.

24. Accounting rates and retail charges have declined for many routes and have dropped significantly for some routes, particularly ones with facilities-based carrier competition on each side, i.e., more than one carrier owning and operating international transmission facilities. However, the rates still vastly exceed cost as evidenced by the existence of arbitrageurs who can exploit the difference between the actual cost of service and what carriers can charge.

25. International Settlement Rates, IB Docket No. 96-261, Notice of Proposed Rulemaking, 12 FCC Rcd. 6184, ¶9 (1996), Report and Order, FCC 97-280 (rel. Aug. 18, 1997)[hereinafter cited as 1997 Accounting Rate Report and Order]. The FCC reports that United States consumers pay on average $0.13 per minute for a domestic long distance call but $0.88 for an international call. See also Organisation for Economic Co-Operation and Development, Committee for Information, Computer and Communications Policy, Refile and Alternative Calling Procedures: Their Impact on Accounting Rates and Collection Charges, OCDE/GD(95)19 (1995), available at http://www.itu.int/intset/dot/dot.htm.

26. In calculating benchmarks the FCC used a version of Total Service Long Run Incremental Cost calculation to establish a "Tariffed Components Price" that uses the three specific network elements identified in ITU-T Recommendation D.140 as the recommended basis for establishing cost-oriented settlement rates: (1) international transmission facilities; (2) international switching facilities; and (3) national extension (domestic transport and termination). 1997 Accounting Rate Report and Order at ¶45.

27. Id. at ¶90. The FCC based its national income classifications on Social Indicators of Development, (Washington, D.C.: The World Bank, 1996).

28. Alternatively, the MSS operator may have assumed that the accounting rate issue does not present a grave problem, because 1) accounting rates will quickly trend downward to cost; or 2) most call terminations will occur on low accounting rate routes (primarily high volume routes to developed countries) thereby offsetting calls subject to high accounting rates and making it possible to offer an averaged and fixed "postalized" rate for all terminations.

29. Regulation of International Accounting Rates, CC Docket No. 90-337, (Phase II), Fourth Report and Order, FCC 96-459, 1996 WL 691815 (F.C.C.) at ¶73 (rel. Dec. 3, 1996)(permitting carriers to negotiate alternatives to the traditional settlement rate system for routes where effective competitive opportunities exist for U.S. carriers).

30. "Calls made via the Globalstar system are routed through the existing national infrastructure, ensuring that PTTs will receive their fair share of the revenue stream, and be able to exercise their customary authority. . . . The Globalstar system, for example, will be fully integrated with existing fixed and cellular networks, and does not by-pass the PSTN. It will therefore fully comply with national service preferences, and the system can deny service to unauthorized users." Globalstar World Telecommunications Policy Forum Presentation.

31. Key officers of the ITU have made consensus building for Global Mobile Personal Communication Systems a priority. ITU forums have developed a set of principles and recommendations "reflect[ing] an emerging common understanding among policy makers and regulators and GMPCS operators about their common interest in achieving the early deployment of GMPCS systems, and realizing the full economic benefits of deployment, in a manner consistent with the goals of national policy in each ITU member country." International Telecommunication Union, World Telecommunication Advisory Council (WTAC) Report to the Secretary-General on GMPCS, (Jan 19, 1996), available at http://www.itu.int/ pforum/ wtacrepe.htm. However, the most concrete consensus document addresses the transceiver portability and the willingness of nations to permit use of such devices even if they have been licensed by another national government.

32. "Rapid deployment of GMPCS on an economically viable basis will only be possible if GMPCS operators are able to interconnect with the pre-existing public network, and if they can do so on technically and commercially reasonable terms. Further work on interconnection policy is desirable to clarify policy alternatives and assess the feasibility and desirability of achieving compatibility of national regulatory policies concerning GMPCS." Id.

33. Additional payments might be due the "host" PTO of country where a handheld transceiver call originated. If a call originated via one or more terrestrial networks, then the wireline carrier probably would receive an access payment as would the originating gateway operator. Some routing scenarios can involve both an originating and terminating gateway operator. .

34. An FCC compilation of U.S. accounting rates is available at http://www.fcc.gov/ib/td/pf/consolar.xls (excel file).

35. The Office of Telecommunications has compiled United Kingdom accounting rates and has made them available at http://www.oftel.gov.uk/feedback/interac1.htm.

36. While international accounting rates are positively correlated with distance, the degree of competition has the most significant impact on the accounting rate for any particular route.

37. The system architecture of Iridium limits the number of gateways with which a satellite can communicate possibly limiting or prohibiting subsequent construction of additional gateways.

Mobile Satellite Services: Service Implementation will Determine Winners and Losers

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ABSTRACT

In 1998, commercial mobile satellite services (MSS) will become available through IRIDIUM and possibly Globalstar. Other entities are building mobile satellite systems for commercial availability in the Twenty-first century. The regulatory and service challenges of delivering MSS to millions of customers are of such a magnitude that the technical risks in building and launching multiple satellite constellations will appear minimal by comparison. Service delivery will be challenging and complicated because it will be carried out by various entities not under the control of satellite owners.

INTRODUCTION

Sometime this year, assuming continued success in implementing mobile satellite systems, commercial mobile satellite services (MSS) will become available through at least IRIDIUM and possibly Globalstar. ICO Global Communications is progressing toward commercial service by the year 2000. Regional geostationary systems are completing their financing and building their systems. As the satellites are launched, increased attention turns toward the ground segment. It is apparent that the challenges of implementing the ground segment necessary to deliver mobile satellite services to millions of customers are of such a magnitude that the technical risks involved in building and launching multiple satellite constellations will appear minimal by comparison. Service delivery – particularly the way the MSS providers have structured it – will be challenging and complicated because it will be carried out by various and diverse entities not under the control of the satellite system owners.

Each Big LEO mobile satellite service provider is planning to offer mobile satellite services on a wholesale basis. Each provider must arrange to sell capacity to cellular operators or other wireless providers who in turn will retail to the consumer. As a result, MSS operators will be to some extent dependent on the motivation and efforts of other entities for marketing, pricing and sales support.

Following a summary of projections for the mobile satellite market, this paper will explore the different approaches being used by the leading mobile satellite service providers to deliver their services. As will become apparent, there are myriad details and complexities that each operator will need to control and manage in order to realize revenue streams in the billions of dollars.

WHAT'S AT STAKE: THE SIZE OF THE MARKET

Over the last five years, Leslie Taylor Associates has closely studied the developing market in mobile satellite services. Last year, we released a comprehensive look at both the voice and data-only MSS market which included market projections for global voice MSS market. Our study revealed a potential worldwide market of some 11 million voice subscribers by 2004, generating annual revenues of $30 billion. By the year 2000, there will be at least two Big LEO systems in operation. One will be providing communications services primarily to the high end of the market and the second will focus on extending the terrestrial fixed and mobile infrastructures in countries around the world. By 2002, a third Big LEO is likely to enter the market, creating additional competitive pressure on both Big LEO and regional geostationary MSS systems.

To fill in cellular and terrestrial communications infrastructure gaps, there will also be two regional (geostationary) systems over the Asia/Pacific market. They benefit from the ability to launch and build their systems rapidly, and provide primarily cellular fill-in and regional roaming services possibly at lower prices than the Big LEOs.

One of the key populations of the MSS market segments is the "International Business Traveler." How large is that segment? In 1995, almost 600 million people traveled beyond the borders of their respective countries. That figure is expected to grow to at least 700 million by the year 2000. Of the total number traveling internationally, almost one-fifth do so on business, resulting in a total addressable market for mobile satellite communications, in the year 2000, of some 119 million travelers. Even a segment of the non-business travelers will be interested in continued easy access to mobile telecommunications and also will be customers.

Looking specifically at the US reveals an addressable market of 3 million Americans who travel beyond US borders, on business, to places with inadequate terrestrial communications. They will form the main target for the US portion of the global MSS market.

Another significant market segment for the MSS industry is telecommunications infrastructure in developing countries. Even in certain urban areas of developing countries, there are long waiting lists to receive telephone service. And, while cellular services are widely available in all major cities around the world, the rural build-out is proceeding at a much slower pace than has been experienced in the United States and Europe. Indonesia, for example, has a cellular penetration rate of 0.15%. The Philippines and Thailand have slightly higher rates, 1.2% and 2.4% respectively, but both are substantially below levels in industrialized countries where 20% and up penetration is common. The MSS operators are, quite correctly, targeting this market of underserved consumers.

Revenue figures for the mobile satellite systems vary considerably depending on the assumptions made. For the sake of simplicity, we assumed, in our study, retail prices of $3 per minute for the first Big LEO and prices of $1 per minute for the second big LEO and regional mobile satellite systems. Throughout the projection period, LTA assumed a constant average number of minutes per subscriber for each mobile satellite system, and a constant average for per minute price. Our results show a potential annual revenue of some $30 billion by 2004.

However, market projections are meaningless if the service is not available on a retail level. As will become apparent when we explore further the myriad details involved in actually delivering mobile satellite services, there will be a number of challenges to be faced in implementing mobile satellite services. These customer and revenue figures will not be realized unless the MSS owners are successful in building, launching, marketing and delivering MSS on a timely and cost effective basis and have committed, and motivated end-service providers promoting use of the service.

THE GROUND NETWORK: THE LINK BETWEEN SUBSCRIBER AND NETWORK

The ground network is the link between the subscriber and the satellite network. While subscribers are not concerned with the number or type of gateways, or even with their location, they will be sensitive to quality of service and cost issues, both of which will affect gateway operations.

As a rule, the space segment owners have contracted out the design and development of the ground segment, and in two cases out of three, have decided against owning that segment. IRIDIUM and Globalstar, for example, expect their investor service providers to own and operate the gateway network. ICO, however, will own its "Satellite Access Nodes (SANs)," contracting with certain investors to manage and run the facilities.

Design and development of the ground infrastructure was an integral part of the overall system design of the Big LEO systems. However, all three MSS providers contracted out, to other parties, the responsibility of ground system design and manufacture. IRIDIUM contracted with Motorola for development of the IRIDIUM ground infrastructure. In Globalstar's case, Qualcomm designed the earth station network. For the ICO network, an international consortium, led by NEC Corp., is developing the ground segment design and equipment.

With the ground network now designed and manufactured, the satellite operators now face three major challenges, including technical, regulatory and commercial, to ensure that service is implemented and marketed.

From the technical perspective there are various issues, including finding an optimal site for gateway earth stations, building the stations, obtaining the appropriate export/import licenses, and procuring and installing switches and other equipment. Other considerations include developing the software to run the network (including operations, billing, customer service and other functions); the software must be capable of running in many countries and must be flexible enough to accommodate local needs while still meeting corporate requirements. IRIDIUM, in a September 1997 filing with the US Securities and Exchange Commission, acknowledged that the development of the software for its system was "one of the largest and most complex software creation and integration tasks ever undertaken in a commercial satellite communications program." Finally, the gateway must be supplied with reliable, continuous power supplies, and these differ from one country to the next.

Then there are regulatory issues: each system needs government approval to operate the gateway control stations in the appropriate frequencies; to use the terminal uplink spectrum L-band frequencies for mobile satellite services; to enable consumers to operate the subscriber terminals for mobile satellite services; to serve as an international carrier, if necessary; and to be able to connect to the Public Switched Telephone Network (PSTN). In some cases, the gateway operator will be responsible for all these regulatory actions. In other cases, the gateway operator will be working with retail cellular or wireless service providers to implement the service and obtain appropriate authorizations.

This brings up the third area of complexity, which is the need for different business relationships for the MSS operator. Each MSS operator needs partnership agreements with either investors or other entities interested in providing MSS service in their respective countries. In addition, service agreements are required with cellular and/or wireless service providers to deliver the service to the consumer or business. Interconnection agreements are needed between the gateway operator and the operator of the country's PSTN. Roaming agreements are needed to enable the customer to travel unfettered, connecting via satellite or cellular system regardless of location.

A further complication is the concern on the part of many government authorities over potential revenue bypass posed by these mobile systems. Some form of revenue-sharing agreements will no doubt be required in many countries. In general, these agreements will be between the local service provider and other telecommunications providers (local and long distance) and in some instances with government entities.

The MSS operators have taken slightly different approaches on this issue. IRIDIUM, with its complex space segment, has placed its technical sophistication on the satellites to accomplish some of the connecting and switching. Accordingly, it is planning a network that will need only 11 gateways, all owned by investment partners, to provide commercial, global voice communications services. Globalstar, on the other hand, is building a less complex satellite system and thus requires at least 35 gateways, again, owned by investors, to provide global commercial service. By the time the Globalstar system is completely built out, there may be almost 100 gateways working with its satellite network. ICO is building a 12-gateway network, which it will own. Operations will be contracted to certain of its investors to operate.

The gateway operator, as noted earlier, is a key participant in the implementation of the MSS system. It is instructive to look at the IRIDIUM system for a view of the number of responsibilities required of the gateway operator.

The IRIDIUM gateway operator is responsible for:

- Buying equipment from Motorola;

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- Providing gateway services;
- Getting licenses and permits to construct and operate the gateway;
- Designating service providers;
- Requiring compliance by the service provider with IRIDIUM-mandated guidelines;
- Supporting IRIDIUM positions at World Radio Conferences;
- Entering into settlement agreements with service providers (to permit roaming);
- Establishing interconnection agreements between gateway and local PSTN operators;
- Obtaining any necessary international carrier status to route traffic to and from the country in which it is located;
- Obtaining the right to route IRIDIUM traffic through the PSTN as an international carrier;
- Obtaining the right to route traffic using leased lines; and
- Obtaining the necessary license to import IRIDIUM Business Support Software.

In exchange for meeting these requirements, the gateway operator has the exclusive right to market IRIDIUM services in its territory, and can acquire up to 9 million Class 1 interests at $ 0.00013 per share if they complete the gateway on schedule and meet certain revenue criteria.

Physical construction of nine of the eleven IRIDIUM gateway facilities was completed by year end 1997. Currently, IRIDIUM has commercial operating licenses for gateways in the US, Thailand, and Taiwan. It has experimental licenses in Korea, Brazil, Japan, Russia, and Italy. The Saudi Arabian gateway contract has been signed, with construction due to commence. No action has occurred on the Chinese gateway.

IRIDIUM has service licenses in 18 countries, including the US, Australia, Canada, Thailand, Colombia, Venezuela, New Zealand, Taiwan, Argentina, Cook Islands, Guatemala, San Marco and Micronesia. In addition, it has been awarded provisional licenses in five countries. Distribution agreements have been executed with approximately 40 roaming partners and service providers.

The Globalstar system will begin operations with 39 gateways: four are almost complete in Australia, France, South Korea and the US. Orders for 35 more gateways have been placed by Globalstar's partners, but in order to speed up implementation, Globalstar has agreed to finance approximately $80 million of the cost of up to 32 of the 35 gateways ordered by the service providers. Globalstar expects to recover this cost through the sale of the gateways to the service providers.

Globalstar's strategic partner service providers have been granted exclusive rights to provide Globalstar service in 71 countries around the world. Six additional service providers will offer Globalstar service in 32 additional countries. To maintain their service provider rights on an exclusive basis, the service providers are required to make minimum payments to Globalstar equal to 50% of target revenues. According to Globalstar, based on current market estimates (which will be updated in 1998), such payments total about $5 billion through 2005.

Globalstar will receive a payment of about $400,000 on each installed gateway sold to a Globalstar service provider.

Globalstar has commissioned the design of the gateways from Qualcomm. Ownership and operation however will be the responsibility of service providers in each country or region in which Globalstar operations are authorized. Manufacturing rights will be licensed by Qualcomm to at least one third-party telecommunications equipment manufacturer.

ICO has awarded contracts to several of its SAN operators, including COMSAT for the US SAN, Japan Satellite Phone for an Asian SAN and back up earth station, Deutsche Telekom for the European SAN, INDOSAT for another Asian SAN, and Telstra Australia. Distribution agreements have been signed with service partners in 91 countries, requiring them to market ICO through cellular operators and other service providers; tailor products and applications to meet local or regional market needs; manage, coordinate and support the administrative and technical interfaces with the cellular operators, local service providers and other retail outlets; facilitate market access; and provide customer service and support.

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ICO recently received its first operators license from Korea, and expects other licenses to follow this year.

GETTING THE PHONE TO MARKET: ANOTHER HURDLE

Mobile satellite services will have no value if there are insufficient quantities of consumer telephones of attractive size, weight and price available. The MSS operators have contracted with equipment manufacturers to develop the phones to work with their respective systems. In addition, and in recognition of the importance cellular will be to the MSS market, all of the MSS operators are planning to offer dual mode satellite/cellular phones.

IRIDIUM, for example, has contracted with Motorola to develop the specifications for the subscriber equipment. Motorola has also licensed Kyocera to build IRIDIUM phones, resulting in two potential suppliers of IRIDIUM phones. IRIDIUM has indicated that it may be required to purchase a number of phones, before commercial service begins, to guarantee their availability. In addition, IRIDIUM has indicated that either it, its gateway operators or service providers may end up subsidizing the cost of the hand held phones.

In the Globalstar system, Qualcomm/Sony, Ericsson and TELITAL are developing user terminals with production orders expected to be placed by the end of 1997. Globalstar intends to offer both dual mode and tri-mode phones to access both Globalstar and a variety of local land-based analog and digital cellular services.

Qualcomm has licensed both Ericsson and TELITAL to manufacture Globalstar phones, and has agreed to grant similar licenses to at least one additional manufacturer.

Globalstar will receive up to $10 on each phone, payable until Globalstar's funding of the design has been recovered.

ICO's approach toward handset licensing has been to establish an open standard and license several manufacturers. ICO has contracted with Mitsubishi, NEC and Samsung for mobile satellite terminals, and is negotiating with Ericsson and Panasonic.

However, despite the market projected for MSS, the number of phones to be manufactured will never reach the quantities of terrestrial wireless. Consequently, the actual cost of the phones can never be reduced to a very low number and the system operators and service providers may have to subsidize the phone price to the consumer to generate service revenues.

GMPCS MoU: ROLE OF THE ITU

In light of the plethora of regulatory aspects involved in providing global mobile personal communications services (GMPCS) via satellite and in an effort to facilitate their introduction, the ITU hosted a policy forum to provide an opportunity for system providers and government entities to fully explore the many issues. One of the results was the establishment of a working group which has developed a Memorandum of Understanding to facilitate the free circulation of terminals. The MoU, which was signed in July 1997, agreed on the first set of arrangements for global cooperation on type approvals and licensing terminals and customs procedures to allow unrestricted transborder movement. The GMPCS MoU should prove helpful to reduce the complexities of mutual recognition of type acceptance and facilitate easy roaming across borders.

AMSC - LESSONS LEARNED ON SERVICE IMPLEMENTATION

Having looked at the progress being made by the three leading Big LEO systems, it is instructive to consider the experience of an MSS provider already in operation. American Mobile Satellite Corp., for example, has been providing commercial mobile satellite services since 1993, and has been operating its own satellite since 1995. Like the MSS providers described above, AMSC planned to wholesale most of its satellite capacity. It, too, envisioned offering space segment to a multitude of cellular service providers, enabling AMSC to leverage off their expertise and access to the consumer market. To that end, in the years before its satellite's launch, AMSC devoted considerable marketing effort towards obtaining resale agreements with retail wireless providers. By the time it launched its satellite in 1995, AMSC had agreements with 156 authorized service providers (mainly cellular operators) covering 70% of the US population. While AMSC had been busy building its satellite and ground network, however, several events conspired to frustrate AMSC's original business plan. Among those challenges were difficulties in getting sufficient numbers of consumer telephone handsets to market, and the extensive terrestrial cellular build-out in the US, which has involved a large percentage of the country. Out of necessity, having seen its consumer market fail to materialize, AMSC has since radically redefined its business plan to no longer rely on cellular operators to market its service. Instead, it is concentrating on business to business marketing, focusing on fleet management applications for both voice and data applications. The consumer market is no longer the primary focus of its marketing efforts.

Like AMSC, the Big LEOs and GSO MSS systems must contend with extensive terrestrial cellular build-out as well as roaming among terrestrial systems. In particular, GSM systems permit roaming in literally dozens of countries. Like AMSC, the Big LEOs and GSO MSS systems will have to assume an active role in getting their handsets and service into the marketplace.

CONCLUSIONS

The mobile satellite market is as complex as it promises to be lucrative. To realize the levels of subscribers and revenues that LTA as well as others have projected, the mobile satellite industry has to meet and overcome many challenges, including the technical, regulatory and business ventures addressed above.

International Agreements and the Roll-out of Hand-held Mobile Satellite Services

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1. ABSTRACT

There are a number of international agreements that were initiated during 1997 that will have a significant impact on the start-up of hand-held mobile satellite service. These include the World Trade Organization's Basic Telecommunications Agreement; the Global Mobile Personal Communications Systems by satellite memorandum of understanding and associated arrangements; and bilateral and regional satellite agreements. All of these agreements promise to advance the ability of satellite service providers to gain faster and better access to telecommunications markets worldwide. They also give governments the opportunity to discuss and develop consensus on the terms for such access on a multilateral level. These agreements, however, are not complete panaceas and need continued efforts to bring all their promised benefits. This paper discusses the achievements of these agreements and the challenges which mobile satellite companies still face despite the multilateral accords.

2. WORLD TRADE ORGANIZATION AGREEMENT ON BASIC TELECOMMUNICATIONS

2.1 BACKGROUND

Established in 1995, the World Trade Organization (WTO) is an inter-governmental organization set up to oversee the rules of international trade in goods and services. Its purpose is to help trade flow smooth, in a system based on rules, to settle trade disputes between governments, and to organize trade negotiations. The WTO seeks to achieve freer trade through negotiation; more predictable trade policies around the world through the disciplines of the WTO agreements; greater trade overall; and a better allocation of resources. The international organization that preceded the WTO was the General Agreement on Tariffs and Trade (GATT), although the GATT agreement is now part of the WTO agreements. The GATT deals with trade in goods, the General Agreement on Trade in Services (GATS) deals with trade in services, and the Agreement on Trade-Related Aspects of Intellectual Property (TRIPS) deals with such issues as copyright, trademarks, patents, industrial designs, and trade secrets. The WTO continues to oversee the implementation of the agreements reached in the 1986-94 Uruguay Round of world trade talks. The Uruguay Round led to the creation of the WTO.

The GATS has three basic principles: (1) all services are covered except those provided in the exercise of governmental authority; (2) there should be no discrimination in favor of national providers - the national treatment principle; and (3) there should be no discrimination between other Members of the Agreement - the most-favored nation (MFN) principle.

The WTO Group on Basic Telecommunications concluded on February 15, 1997 after several years of negotiations. At the end of these negotiations, 69 countries representing more than 95% of the world's telecommunications revenues had committed, in whole or in part, to liberalize their communications regulations and open their national markets to foreign service suppliers. These commitments are to be ratified on November 30, 1997 at which time they will become legally binding. Many of the commitments will take effect starting January 1, 1998.

Important elements of the commitments made under the WTO Basic Telecommunications Agreement (BTA), like those of other trade commitments under the GATS, include the "service sectors" covered by a commitment, the "modes of service supply" covered; and any "limitations" on market access or national treatment for service suppliers of WTO Member States. Members may also make additional commitments which may not fit easily in the above categories. *Service sector* applies to the special service for which a Member may wish to identify special conditions of access (such as for local, domestic or international long distance telephony). The *modes of service supply* include any conditions for the cross-border supply of service; the consumption of the service abroad; whether service suppliers of other Members must establish a commercial presence in the Member country, and whether there are any rules regarding the presence of natural persons. *Limitations on market access or national treatment* refer to limitations which a Member may place on a service sector, a mode of supply or a service supplier within its country. Once commitments are ratified and become legally binding, Members may not downgrade their commitments. Members may improve their commitments at any time.

2.2 ACHIEVEMENTS OF THE WTO BASIC TELECOMMUNICATIONS AGREEMENT

2.2.1 Significant Markets Have Participated

The WTO Basic Telecommunications Agreement has substantially advanced the liberalization of telecommunications in many major markets. The participation of 69 countries establishes a significant foundation on which to build the global telecommunications market for the next century. Mobile satellite services are uniquely and clearly positioned as a basic telecommunications service enabling MSS service providers and satellite operators greatest access to the markets liberalized through the WTO.

Specifically, for *international services and facilities* (these include international wireline, international wireless, and international satellite services unless conditioned in a Member's commitment), 52 countries guaranteed full market access; and an additional five countries will open their market for selected international services. Commitments to fully open national markets to all *satellite facilities and service providers* totaled 49 out of the 69 country commitments: 26 of these commitments start in 1998 and a further 14 Members will open up for satellite services over the next five years. Furthermore, many countries offered flexibility for *foreign ownership* or control of all telecommunications services and facilities in-country: 24 Members will offer this flexibility starting in 1998, with another 20 to open over a phased-in period; and 12 further countries indicated that they would permit foreign ownership for specific telecommunications services.

2.2.2 Reference Paper on Regulatory Principles

As mentioned above, during negotiations Members may make "additional commitments". Many countries adhered to one important consensus document of the WTO Basic Telecommunications Agreement in their additional commitments: the Reference Paper on Regulatory Principles. This appendix to national commitments legally bound 55 countries to guarantee the pro-competitive Regulatory Principles, with an additional four nations guaranteeing the Regulatory Principles in the future, and a further six governments committing to a portion of the Regulatory Principles.

The main elements of the Regulatory Principles committed countries to establish *competitive safeguards* to prevent anti-competitive practices (such as anti-competitive cross-subsidization). Furthermore, the Regulatory Principles ensure that suppliers of public telecommunications networks will allow all users to *interconnect* under non-discriminatory terms, conditions, rates and quality of service in a timely, transparent, and reasonable fashion. The procedures for this interconnection must be publicly available, as must be the resulting interconnection agreements or offer; and a mechanism for resolving disputes in a timely way with an independent domestic body must be made available. The Regulatory Principles confirm the right of nations to define the kind of *universal service obligations* they wish to maintain, but these may not be anti-competitive and must be administered in a transparent, non-discriminatory and competitively-neutral manner. *Licensing criteria* must be publicly available and the reasons for denial of a license must be made known to applicants. Countries adhering to the Regulatory Principles also agreed to establish an *independent regulator* separate from and not accountable to any supplier of basic telecommunications services. Finally, with regard to any procedures for the *allocation and use of scarce resources* (Reference Paper, paragraph 6), including frequencies, numbers and rights of way, countries agreed they would be carried out in an objective, timely, transparent and non-discriminatory manner. The current state of allocated frequency bands must be made publicly available.

2.2.3 Dispute Resolution

The WTO has one unique feature that is not shared by the other two agreements affecting mobile satellite service provision -- a legal mechanism to enforce national commitments. Under the WTO's dispute resolution procedures, WTO Member countries who believe that their service suppliers have been denied the benefit of the commitments made by another Member, may take the case to a WTO dispute resolution panel. If the panel concludes that the complaint is justified, and if the Member continues to not comply, the aggrieved country is permitted to take legal trade retaliation to the value of the denied market access, in any service or goods sector between the two nations.

2.3 WTO's REMAINING CHALLENGES

2.3.1 Important Markets Missing

Clearly the WTO Basic Telecommunications Agreement is a very significant achievement for broad market liberalization. Equally as clearly, for a satellite service provider to successfully provide its services on a global scale, it must be permitted to serve as many nations in its coverage area as possible. There are several significant and important markets which did not make market opening commitments, or who are not yet members of the WTO. Certain key satellite marketplaces resisted or limited liberalization during the 1997 negotiations, including Argentina, Brazil, India, Indonesia, Malaysia, Pakistan, the Philippines, South Africa and Thailand. Nations with large satellite markets which are not yet members of the WTO and who must consider future market access commitments for basic telecommunications, include the People's Republic of China, Russia and Saudi Arabia. Satellite companies wishing to access these markets will find that the WTO has not significantly changed their ability to provide satellite services to, from, or within these countries.

2.3.2 Spectrum Allocation and Assignment

Throughout the last year of the basic telecommunications negotiations, nations asked when domestic spectrum management - particularly as it relates to global or regional satellite systems - is considered a legitimate and sovereign policy activity under the GATS, and when spectrum decisions could pass over the line to become a barrier to trade? The group closed in around the view that the GATS controls the application of policy objectives, such as spectrum management, through the requirements for most-favored-nation treatment (GATS Article II), the disciplines on domestic regulation (GATS Article VI), and the provisions of GATS Article XVI defining market access limitations that must be listed to be maintained. A few weeks before the negotiations closed in February 1997, the Chairman of the negotiating group submitted a Note to the plenary meeting regarding market access limitations on spectrum availability for consideration. Although not formally adopted, the Note was heavily used by nations to guide the drafting of commitments on spectrum availability, and has been incorporated into the negotiating history for the talks. The Chairman's Note concluded that:

> "Spectrum/frequency management is not, *per se*, a measure which needs to be listed under Article XVI. Furthermore under the GATS each Member has the right to exercise spectrum/frequency management, which may affect the number of service suppliers, provided that this is done in accordance with Article VI and other relevant provisions of the GATS. This includes the ability to allocate frequency bands taking into account existing and future needs. Also, Members which have made additional commitments in line with the Reference Paper on regulatory principles are bound by its paragraph 6."

The GATS Article VI requires that all domestic regulations be established and managed in an objective, timely, transparent, non-discriminatory and least-burdensome manner. The GATS Article VI and the Reference Paper paragraph 6 on allocation of scarce resources should ensure that global and regional mobile satellite operators and service providers will be given fair consideration in the allocation and assignment of frequencies on a national level. The Chairman's Note on Spectrum Availability should give regulators the comfort and guidance they need to proceed with spectrum management activities in accordance with the GATS principles. The implementation and testing of these premises over the next few years will demonstrate whether in fact spectrum management can be fairly conducted under GATS Article VI, or whether countries will use spectrum management as a means of introducing or maintaining competitive imbalances.

2.3.3 National Security Concerns

This is another area where mobile satellite systems could face difficulty. The GATS contains specific exemptions for governments to deny market access or national treatment for purposes of national security and law enforcement. While the WTO BTA has achieved significant and useful market opening commitments from large telecommunications marketplaces, it will be up to MSS operators to provide the assurances to governmental authorities that the provision of transnational mobile satellite services will not cause unmanageable national security or law enforcement problems. Without these assurances, governments may seek refuge behind the GATS exemptions.

2.3.4 Scope of the Agreement

The WTO Basic Telecommunications Agreement suffers from a certain lack of self-definition and from the rapid development of innovation in the communications field. The GATS Article XXVIII defines the "supply of a service" as the production, distribution, marketing, sale, or delivery of a service. However, when the Group on Basic Telecommunications was established, the term "basic telecommunications service" was not defined. Many nations raised the question (and continue to question) where the negotiating group as a whole, and countries individually, drew the line between "basic telecommunications" and other communications. Did the negotiating mandate include all communications such as telephone, telex, telegraph, data, paging, video (point-to-point, and point-to-multipoint) and multimedia (interactive or one-way) communications? The group further asked, if the mandate only included some of these services, how could the impermissible be enforced in a digital world? These questions and the lack of precise definitions led many countries to take market access limitations or MFN exemptions for certain services.

The convergence of communications technologies and services -- telecommunications vs. one-way media vs. interactive media -- has created an extremely difficult environment for governments to draw rigid trade distinctions. The next generation of mobile satellite systems will require the flexibility to provide the full gamut of traditional, content-based, and personal interactive communications services. There has been some discussion that multimedia communications and other convergence issues will be taken up for review at a new round of negotiations scheduled to start in 2000.

Another question of scope was also considered during the last few months of the negotiations. Were the inter-governmental treaty-based satellite systems (e.g., INTELSAT, Inmarsat, EUTELSAT and others) beneficiaries of the WTO structure and final commitments? An informal consensus developed around the understanding that the organizations were not "service suppliers *of* a Member" country pursuant to the GATS, and therefore that they could not be beneficiaries of the final BTA (or other WTO offerings). While this was not memorialized in a formal document of the negotiations, it may ultimately become academic if the inter-governmental organizations become private, national law companies.

2.3.5 Regulatory Preparedness

Although countries have made liberalizing commitments to introduce competition in their telecommunications markets, many are struggling with exactly how to implement their commitments. Specifically, these countries may be uncertain as to how to authorize global mobile satellite systems to operate within their territory. They may be unclear as to which regulatory models to follow (USA vs. Europe vs. other approaches) or whether they should simply rely on the technical guidelines and clearances provided through the ITU. The ITU and nations with developed regulatory systems can provide assistance and information to governments just now developing their regulatory systems. Mobile satellite systems operators and service providers will need to further support these countries in developing creative regulatory approaches which satisfy both government and business requirements.

3. THE ITU AND GLOBAL MOBILE PERSONAL COMMUNICATIONS BY SATELLITE

3.1 BACKGROUND

The first World Telecommunications Policy Forum (WTPF) was proposed by the 1994 Kyoto Plenipotentiary Conference and took place in Geneva in October 1996. The purpose of the WTPF was for all ITU Member countries and participating private sector entities to address the policy and regulatory issues raised by the introduction of global mobile personal communications systems and services by satellite (GMPCS). GMPCS systems can be geostationary or non-geostationary, fixed or mobile, broadband or narrowband, global or regional, but must be capable of providing services directly to end-users. Documents submitted prior to the forum demonstrated that there were three main perspectives on GMPCS systems: (1) satellite operators and service providers stressed the need for open, equitable, and non-discriminatory access to national markets on a global basis; (2) regulators from developed countries supported open market access but indicated that the results of the forum should be non-binding on Member governments; and (3) regulators from developing countries emphasized the issues of national sovereignty and revenue bypass concerns.

At the October 1996 meeting, 128 ITU Member countries and 70 private sector members committed to work together on common understandings for use by service providers and governments in the licensing of GMPCS systems and services worldwide. The draft Memorandum of Understanding (MOU) which resulted from this meeting was to be used as a framework for arrangements to facilitate the global circulation and transborder roaming of GMPCS terminals. Specifically, the draft MOU called for agreement on such critical commercial requirements as multinational type approval of hand-sets, licensing of terminals, marking of terminals, free circulation of terminals across borders, and access to traffic data (customs issues were added later). Another important set of guidelines established by this meeting were the set of ten voluntary principles outlined in Opinion 2 of the October 1996 WTPF Report. These principles addressed concepts of early introduction, international cooperation, global service availability, GMPCS regulation, investment participation, unauthorized use, user terminal and free circulation, universal access, interconnectivity, and further cooperation. The October 1996 session called for another meeting to take place in February 1997.

The February 1997 MOU working group finalized the MOU. More than 120 delegates adopted the document, including 88 ITU Member states and 40 private sector members. The MOU was sent out to all ITU delegations for formal signature. In July 1997, the working group met again and agreed on the first set of arrangements under the GMPCS MOU, including (1) the mutual recognition of GMPCS terminal type approvals; (2) a simplified process for the licensing of GMPCS terminals; (3) a method of identifying (marking) GMPCS terminals; and (4) access to traffic data by authorized national authorities. Recommendations on principles for customs procedures in support of the unrestricted circulation of GMPCS terminals across borders were also agreed.

The October 1997 meeting approved the final text of all arrangements. The ITU Secretary General invited all Member countries and private sector participants to begin to implement the arrangements. The ITU, as depository for these arrangements, will maintain a list of standards and type approval specifications, and will monitor the implementation of the MOU arrangements. All recommendations contained in the arrangements are voluntary and are consistent with the ten voluntary principles adopted by the October 1996 WTPF.

As of early November 1997, 18 ITU Member states plus the European Union had formally signed the MOU as well as by 46 private sector member entities. The governmental signatures as of early November were: Argentina, Brazil, Cameroon, Chad, European Union, Finland, Indonesia, Italy, Japan, Kenya, Korea, Laos, Lebanon, Monaco, Mongolia, Norway, Tanzania, Tunisia, and USA. Implementation procedures are beginning to ramp up in some of these and additional countries already.

3.2 GMPCS ACHIEVEMENTS

3.2.1 Worldwide Discussion on Matter of Concern to Many Countries Achieved

Given the high level of concern about GMPCS systems expressed by nations worldwide at the 1994 Kyoto Plenipotentiary, the conclusion of the informal multilateral process in October 1997 marked a very significant achievement for the participating governments, GMPCS system and service operators, as well as for the ITU itself. Oftentimes, the opportunity to frankly discuss concerns leads to increased understanding and consensus on possible solutions and next steps.

3.2.2 Significant GMPCS Principles Agreed

The sometimes low-profile GMPCS process has achieved in one year what mobile satellite proponents have been seeking for more than a decade. Critical principle agreements of the GMPCS MOU and arrangements include:

- GMPCS systems will be coordinated in accordance with ITU Radio Regulations;
- GMPCS systems will be subject to the national laws and regulations of each country where GMPCS will be providing service;
- Each GMPCS operator will take steps to inhibit the use of its system in any country that has not authorized its GMPCS service.
- To enhance cross-border circulation of terminals, national authorities are invited: to mutually recognize type approval and marking procedures; to recognize type approved terminals when essential criteria in the arrangements are met (marked with "GMPCS MOU" on the equipment); and to work towards a single type approval procedure in the medium- to long-term.
- Administrations are not recommended to require individual licenses for GMPCS terminals as long as they conform to certain criteria in the arrangements.
- Agreement that GMPCS system operators or service providers will provide, upon request, to the competent national authorities implementing these arrangements, GMPCS traffic data originating in or routed to its national territory. These reports will not provide confidential customer information, but must be sufficient to assist with identification of unauthorized traffic flows.

- Requests that nations reduce customs duties on GMPCS terminals placed on the market and to exempt from fees and restrictions, those GMPCS terminals transiting a country on a temporary basis.

3.2.3 GMPCS Fills in Gaps Left by WTO Basic Telecommunications Agreement

The GMPCS MOU and its arrangements address issues and service requirements which were not within the scope of the WTO BTA and possibly not even within the reach of bilateral agreements. For example, the WTO BTA can not effectively address the terminal type approval, equipment standards, or customs issues on which the GMPCS group has developed consensus.

3.3 GMPCS REMAINING CHALLENGES

3.3.1 MOU and Arrangements not Legally Binding

Although the MOU and its arrangements have made significant progress towards the worldwide understanding of GMPCS systems and services, they remain purely voluntary in their recommendations. They provide important guidance to regulators developing regulatory systems in their own countries for GMPCS but ultimately depend on the good will of all signatories (public and private alike) for effective implementation.

3.3.2 No Dispute Resolution

In addition to not being legally binding upon signatories, the GMPCS MOU and its arrangements doe not have a dispute resolution mechanism. Under certain circumstances, if a country withholds market access, a company (through its licensing Administration) could seek redress through the WTO dispute resolution mechanism or through international arbitration where feasible. This would not, however, apply to all matters related to the GMPCS MOU. It is important to note that the WTO dispute resolution mechanism is unusual in the world of trade agreements. Enforcement practices for more than a century have relied on international, generally non-binding, arbitration to resolve disputes.

4. BILATERAL AND REGIONAL SATELLITE AGREEMENTS

Finally, in some cases, bilateral and regional agreements for satellite services offer the potential to build out access arrangements on a more focused basis than at the multinational level. Specific agreements can be made which satisfy localized needs. The U.S. and Mexico have mutually developed satellite services accords which focus on certain satellite services. To date, the U.S. and Mexico have signed three satellite-related agreements:

- In April 1996: the Agreement Concerning the Transmission and Reception of Signals from Satellites for the Provision of Satellite Services to Users in the United Mexican States and the United States of America;
- In November 1996: the Protocol Concerning the Transmission and Reception of Signals from Satellites for the Provision of Direct-to-Home Satellite Services; and
- In October 1997: the Protocol Concerning the Transmission and Reception of Signals from Satellites for the Provision of Fixed-Satellite Services.

The U.S. and Mexico are currently preparing for discussions on a protocol for mobile satellite services in early 1998, and the U.S. and Argentina have progressed significantly towards an agreement on fixed-satellite services.

As specialized and useful as these inter-governmental agreements might appear to be, it will not be feasible for individual governments to negotiate these accords fast enough and broadly enough for the needs of global mobile satellite service providers. Furthermore, mobile satellite services may differ significantly in their need for multilateral breadth than other services such as fixed point-to-point and point-to-multipoint satellite services.

5. CONCLUSIONS

From the satellite service provider perspective, the WTO basic telecommunications commitments combined with the GMPCS achievements offer to catalyze the availability of new-generation mobile satellite services in all countries. In particular, the non-geostationary systems by their very design will facilitate non-discriminatory service to both developed and developing countries. Liberalization and open market access will be phased-in based on the time schedules identified in each country's WTO commitments. By virtue of the WTO's MFN principle, companies from WTO members who did not make commitments will be able to benefit fully from the liberalization commitments that fellow WTO members did make. National commitments for market access will be enforceable under GATS procedures. The GMPCS process provides established templates for companies and governments to start discussions - much of the hard policy work has been completed on a multinational level through the ITU in 1997.

From the national government perspective, both the WTO and the GMPCS processes offer countries who have not participated in the early stages of the negotiations to take part in the growing market for these services. All WTO and ITU member countries will be able to reap the benefits. Through the GMPCS process, regulators from all economies will have the opportunity to express their national needs and concerns, to benefit from the hard work of the GMPCS working groups, and to participate in finding appropriate national solutions side-by-side with the commercial providers. Matters of concern to national regulators will include compliance with national telephony rules, interconnection, universal service, national security, and revenue bypass. Bilateral agreements could provide some of the advantages accomplished by multilateral agreements. However, bilateral agreements are resource intensive and more limited than multilateral agreements can be for multiple parties.

In sum, for mobile satellite service providers, market access has never been more achievable than now with the WTO Basic Telecommunications Agreement and the GMPCS MOU and its arrangements. Without these two multilateral agreements and activities, mobile satellite service providers would not have the benefits of independent, transparent and non-discriminatory regulatory systems; and would need to negotiate for GMPCS service entry on an even more detailed level than they will in the post-1997 timeframe. Bilateral agreements may make incremental progress between some countries for some services but global progress for national governments and mobile satellite service providers will be best achieved through the multilateral telecommunications trade and policy fora of the combined WTO and the GMPCS process. Efforts must continue in these two arenas to improve the number and quality of WTO Member commitments for basic telecommunications, and to add momentum and strength to the GMPCS implementation activities. Multilateral agreements are clearly "greater than the sum of their parts" for all participants.

INMARSAT: A Shared Vision of the Future

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1. ABSTRACT

New technology, new services, expanding markets, growing competition and regulatory changes are all having profound effects on the way Inmarsat will operate in the decade to come. In the face of these changes, this paper provides a perspective on Inmarsat's development and the key strategies it is adopting to meet the growth of competition.

2. INTRODUCTION

Inmarsat was established 19 years ago in 1979 -- initially, to service the maritime community -- but since then its expanded to operate a global satellite communications system serving not only maritime telecommunication needs but also aeronautical, land mobile and other vertical markets including the corporate traveller.

It grew out of an initiative of the then International Maritime Consultative Organisation, now the IMO. The drive was to harness the advantages of the then new satellite communications technology for the benefit of the maritime industries to improve distress and safety communications for life at sea.

At the time of Inmarsat's establishment, mobile communication via satellite was still an unexplored technology, and there was a great deal of doubt in many circles as to whether it would be commercially viable. For this reason it was decided that Inmarsat should be a joint co-operative venture of governments, with their Signatories -- nominee organisations, in most cases PTTs -- contributing the capital and bearing the high risk involved.

Right from the outset, as early as 1983, Inmarsat surprised investors by beginning to provide them with a return. And, as history has shown, that was only the beginning. Demand has continued to rise, new technologies and services have been introduced, and whole new markets opened up and developed.

3. INMARSAT AS A LEADER IN TECHNOLOGY

Inmarsat is still an internationally owned co-operative, now with 81 member countries. The first generation Inmarsat satellite system came into operation in 1982, using the commercial capacity on three Marisat satellites it had inherited from Comsat, augmented by two Marecs satellites from the European Space Agency, and then by Maritime Communications Subsystems on several Intelsat 5 satellites.

From a commercial perspective, Inmarsat quickly exceeded all expectations and within a couple of years was trading with a surplus. As part of this success it became apparent that the type of mobile satellite communications that Inmarsat could provide was of interest for applications well beyond maritime. Indeed, virtually the entire evolution in mobile satellite communications has been pioneered by the Inmarsat partnership. Planning began for the development of what was to become a multi-application global mobile communications network.

This began to become reality with the launch of the world's first dedicated mobile communications satellites -- the Inmarsat-2 series -- in 1990. These internationally manufactured satellites -- major contractors were British Aerospace, Matra and Hughes -- more than doubled the capacity of the Inmarsat system. And they allowed Inmarsat to begin to expand and update the range of communications services -- and terminals -- that could operate with the system.

Throughout the 1980s there was only one mobile satellite service available Inmarsat-A.

Through an evolutionary process that involved shrinking the size and cost of equipment, making terminals more portable, introducing new applications and systems, and lowering production costs Inmarsat has produced a range of other services. Thus, the original somewhat bulky and expensive Inmarsat-A analogue terminals were supplemented by a variety of digital terminals with different specifications and capabilities, making them suitable for a broad range of applications at sea, in the air and on land which include:

- **Inmarsat-A** was Inmarsat's original offering. This analogue system supports phone, fax, telex and data at up to 64kbit/sec for maritime and land-mobile users. More than 25,000 Inmarsat-A terminals are in service.

- **Inmarsat-B**, launched in 1994, is the digital successor to Inmarsat-A. Because it makes more efficient use of space segment resources it permits significant reductions in user charges.
- **Inmarsat-C**, introduced in the early 1990s, supports store-and-forward data messaging at 600 bits/sec to terminals that are briefcase-sized and smaller. Inmarsat-C terminals are in service in maritime, land-mobile, aeronautical and remote-monitoring applications.
- Since 1992 **Inmarsat-M** and 1996 **Inmarsat-phone** has supported the world's smallest satellite phone terminals - briefcase-sized and smaller. Also provided are fax and 2.4kbit/sec data.
- The **Inmarsat-Aero** system supports phone, fax and data up to 10.5kbit/sec for the purposes of passenger communications, air traffic control, and airline operational and administrative communications. Almost all the world's leading international airlines have committed to using the system.
- Introduced in 1997 **Inmarsat-D**, offers global messaging to pocket-sized and vehicle-mounted receivers. In 1997 A message-acknowledgement facility was introduced under the enhanced **D+** service

It is worth noting by January 1997 Inmarsat had commissioned 65,000 terminals, today it has over 100,000 in operation around the world. Its revenues continue to grow strongly against a background of continually lower user charges.

Inmarsat is currently enjoying the dawn of the third generation of Inmarsat satellites and services. In late January it will launch the fifth Inmarsat-3, built by Lockheed Martin and Matra Marconi. The deployment of the satellite - an in-orbit spare - completes Inmarsat's global coverage with I-3s giving Inmarsat a total constellation of 9 geostationary satellites.

The Inmarsat-2s more than doubled the previous capacity wit had been operating. The Inmarsat-3s have improved our capacity eight-fold over the Inmarsat-2s. This greatly increased capacity and the Inmarsat-3 spot beam capability are enabling Inmarsat to provide new systems that expand the services available to professional mobile communicators, and other businessmen, professionals and hobbyists who need the support of mobile communications.

These systems provided the basis for the Inmarsat-phone -- the world's first mobile satellite phone. Inmarsat D+, one and two way data and message exchange to pocket sized terminals; and the shortly to be launched Aero-I service, a compact economical multi-channel communications system designed to meet the needs of medium haul airlines.

With around $1-billion in the Inmarsat-3 system -- satellites, launch vehicles and ground segment the risks associated with this massive programme are now largely behind Inmarsat. Today it has a fully-operational system to be used for the benefit of its customers and investors alike.

Inmarsat now faces the challenge of effectively marketing the potential offered by Inmarsat-3 -- a particular challenge for Inmarsat, and its service providers and Partners.

The advanced spot beam technology of the Inmarsat-3 spacecraft, and their overall capacity, is leading to a new range of service products that are bringing the advantages of mobile satellite communications to a much wider global audience.

In addition, the evolution towards an ever-widening family of new terminals and services led to the establishment of ICO. Inmarsat was the founder, and is a major shareholder of, ICO, which is developing an intermediate circular orbit satellite system for hand-held telephone communications. Inmarsat will develop and wholesale some specialised services using ICO satellites for maritime and aeronautical customers, to complement the total range of products Inmarsat supplies to these communities.

Furthermore, Inmarsat has established over the years levels of technical specifications. These are covered in the Specification Development Manuals. In general, these are available to all manufacturers. Inmarsat requires those manufacturers wanting to design products for the services provided by Inmarsat to build to very thorough technical requirements. Once built there is a process of type approval by Inmarsat to manufacturers which can consist of days or months of beta testing of the new equipment.

Over the years this has resulted in a number of specialised manufacturers whose business is to produce products for use with the Inmarsat network becoming established as a flourishing global network which continues to grow as new products are launched.

4. BREAKING DOWN REGULATORY BARRIERS

Technically, it is possible to use satellite communications all over the world. But some countries do not permit the use of Inmarsat equipment -- or make it prohibitively expensive to do so.

Inmarsat is encouraging those countries to remove or reduce the regulatory barriers which restrict or prevent the use of its satcom equipment within their borders.

The organisation is particularly concerned to open up possibilities for users of Inmarsat-phone and users in the land transport, rural and remote sectors, so that international travellers may use their mobile satellite communications systems wherever they are in the world.

Various barriers presently exist. Some countries prohibit any use of mobile satcom equipment. Others permit it only in particular circumstances, such as for disaster relief or emergencies, or in limited geographical areas.

High licence fees, taxes and customs duties put mobile satcoms out of reach of many potential users; in some countries the annual licence fee is several thousand dollars, three times the cost of the equipment itself. Additional type-approval is sometimes necessary, even though the equipment has been type-approved elsewhere or meets internationally recognised standards.

Often these regulatory barriers exist because the country does not have a policy or regulatory framework covering the mobile satellite services or because they fear bypass of their terrestrial network (even in areas where there is no network to bypass). Some countries are concerned that mobile earth stations may be used by drug smugglers or car thieves to avoid detection, but criminals intent on breaking the law will do so anyway. On the other hand, mobile earth stations can be helpful to law enforcement agencies to combat crime. Another reason for regulatory barriers is concern about interference to other telecom equipment, but spectrum sharing studies available from Inmarsat show that sharing is possible.

Restrictive regulations usually impede only the country's own socio-economic and political development, especially in remote and rural areas where Inmarsat terminals tend to be used the most because of inadequate or non-existent alternative facilities. In addition to socio-economic benefits, a liberalised telecom environment will help generate new revenues for service providers and others in the country.

In February 1997, the International Telecommunication Union (ITU) hosted a meeting of 88 administrations, satellite system operators, manufacturers and service providers which agreed a Memorandum of Understanding (MoU), the aim of which is to facilitate the free circulation of global mobile personal communications by satellite (GMPCS) terminals. The MoU group is expected to develop arrangements for type approval, licensing, marking of terminals, customs duties and access to traffic data.

The World Trade Organisation and its member states have also taken steps to liberalise telecommunications services, including satellite services, as a result of the successful negotiations concluded within the Group on Basic Telecoms (GBT) in February 1997 and to lower customs duties on information technology and telecom equipment, including mobile earth stations, in the context of the Information Technology Agreement, agreed by WTO ministers in December 1996.

Regional directors and other representatives of Inmarsat are visiting telecommunications ministers in different countries to discuss trans-border agreements.

Inmarsat's short-term targets include the reduction of import duties to around 10 per cent of the equipment's purchase price (or, in one case, by 98 per cent) within six months to a year; reducing licence fees (by about 95 per cent in some cases) within six to nine months; and for regulations to be changed to permit the use of Inmarsat-phone in a number of countries where it is presently not allowed.

5. INMARSAT TODAY

Inmarsat today is a financially successful and thriving mobile satellite service partnership. It has evolved from a single service system into a full-service global mobile-satellite system for all mobile user communities - maritime, aeronautical, and land - with multiple services. It operates globally but acts locally through Signatories and other service providers who act Inmarsat services to end-customers. In the same time revenues have grown many-fold. Inmarsat has been the chief architect behind growth of mobile satellite communications and has greatly benefited the newcomers to the game. Indeed, many of the personnel working for the newcomers actually got their starts with some of the Inmarsat signatories or the organization itself.

6. TOWARD A SHARED VISION OF THE FUTURE

While there is always uncertainty in trying to predict the future, Inmarsat has developed a strong and coherent vision of the future upon which its strategic approach is based. It is focusing its efforts around five strategic initiatives:

- building further Inmarsat's position as a leading provider of satellite telecommunications in our key maritime, aeronautical and land mobile markets;
- improving the yield from its second and third generation of satellites by innovative pricing and services which will appeal to a new range of markets;
- expanding and continuing to expand Inmarsat's distribution channels, especially with regard to some of the new products and services Inmarsat has recently introduced and ensuring integration of mobile satellite service in mainstream communications;
- Inmarsat it is building a more effective presence in some of the regional markets.
- Along with its partners it is aiming to get closer to its customers whoever they are. It is listening to their needs and working with them to ensuring that it provides good support to keep their loyalty.

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7. THE CHALLENGES

7.1 There are new challenges as Inmarsat moves forward. These include:

- vast new markets - global mobile traveller
  - global mobile office;
- the need for package solutions and pricing flexibility
- the need for new ways of doing business;
- the need to restructure to provide more choices;
- Competition is exploding around the world which is in turn leading to an increase in choice for customers, a fall in real prices and an increasingly rapid rate of innovation.

Inmarsat faces challenges on two fronts -- from existing regional mobile satellite communication operators and from new companies such as Iridium, Globalstar and Odyssey.

But some of the newcomers to the field of mobile satellite communications have yet to face up to many of the challenges ahead of them which include:

- keeping a project of the magnitude of a satellite system within long term financial projections;
- terrestrial cellular systems encroaching into less populated areas;
- successfully optimising the distribution chain, through service providers to end retailers;
- the pace of technological and market change.

Ultimately, the billion dollar question for all is how many global LEO and MEO operators and regional GEO aspirants can the market sustain? All are entering an industry -- mobile telecommunications -- which has increasingly narrow margins and an increasing focus on niche markets. Where there are few precedents it is clearly a major challenge to accurately determine the viability of several operators catering for the needs of the market.

7.2 INMARSAT'S STRATEGIC APPROACH

a. The enhancement of existing services

Although a key strategic focus is mobile multi-media satellite communications, Inmarsat is fully committed to the provision and further development of services to traditional markets such as the aeronautical and maritime communities and specialized land mobile markets. This is not only important for the customer and for Inmarsat, but for Signatories who have built their Inmarsat business, to date, on serving these traditional customers. Continuous development for its existing markets offering greater value to our existing customers.

Inmarsat has also taken on and will continue to provide important public service obligations, such as safety and distress services. These services are core to its business today and will be closely protected if it ultimately becomes a full blown commercial company.

b. The development of present and future markets

As the decade progresses, Inmarsat's traditional markets in the maritime, aeronautical and land mobile communities will be joined by vast new markets for personal and multi-media mobile satellite communications.

These markets will include business travellers, cellular extension and national roaming markets and Inmarsat services will attract those who are out of reach of cellular service or who move through areas of incompatible cellular systems. Given that cellular is expected to reach less than 60 per cent of the world's population by the year 2000, the potential is considerable and in developing these services Inmarsat is tracking developments in the terrestrial mobile networks to ensure that its services present a complimentary extension to meet the needs of these markets.

c. Inmarsat's marketing strategy

A strong marketing strategy for developing its mobile satellite family of services is seen as one of the keys to success and to meeting competition. Central to this strategy is that each member of the family is a part of a total, integrated service strongly branded and marketed under the *via Inmarsat* umbrella.

With proven services already on the market Inmarsat begins with significant strategic and commercial advantages ahead of the forthcoming competition.

Today, Inmarsat has very focused vertical markets. It does not see itself competing with the LEOs. Their paths will cross but the market strategy is to provide services to the global mobile office. This is not just a phone (voice service) but a complete communications package: voice, data, e-mail, internet, fax and video-conferencing. This is an evolutionary path for Inmarsat -- not something new and untried

d. The development of *personal* mobile satellite communications

Longer-term, the personal mobile satellite services has been considered the next step in the organization's strategy. The focus is on:

- identifying business opportunities in the first decade of the next century;
- select the most promising;
- identifying the most effective technical and commercial means of delivering these services;
- planning for their introduction and for the space segment needed to support them;
- promoting timely implementation.

These developments have been integrated under a programme umbrella known as Horizons. Inmarsat's research has concluded there is an unserved need for satellites delivering service with greater functionality than handheld satellite communications and greater mobility than VSAT-based services. The Horizons plan builds on Inmarsat's demonstrated expertise in delivering satellite services to terminals, to provide high bandwidth data channels with high frequency re-use at a low price per bit to mobile users. It will be a Personal Multimedia Communications service, providing standard office applications to standard portable, PC based terminals. It is anticipated that the new system will operate alongside the current satellites by 2001 or 2002, providing a wide range of multi-media services to mobile terminals.

There seems little doubt that mobile satellite operators will be called on to support much higher data rates than are the norm at present. Project Horizons is being driven by the market, *not* the mechanics of satellite communications. Inmarsat has in the past been accused of being an engineering-led organisation, delivering technical excellence in its own time. Technology obviously *will* have a bearing on what Inmarsat offers in the next century but it has moved to a marketing led operation.

d. Strategies for institutional change

Because of changing technology, services and markets, it will not be possible in the future to operate the mobile satellite business in the same way as has been done in the past. Although successful now, Inmarsat needs to change in order to be ready to succeed in the emerging environment. During 1997 a major effort was directed at finding the most appropriate structure for Inmarsat itself, an effort which involved Signatories, Council, Parties and the Directorate to determine the:

- the appropriate legal form for Inmarsat;
- governance /management flexibility;
- valuation / investment / shares;
- ground segment infrastructure;
- service provision / marketing / tariffs.

8 CONCLUSION THE INMARSAT ADVANTAGE

Inmarsat has begun the push to anticipate and answer the many other needs of the 21st century mobile satcoms community. The future of communications lies in the Internet, and Inmarsat has the products to enable people to use the Internet. The organisation believes it has the ability to greatly influence the work and leisure lifestyles of millions of people around the world. The task is demanding but certainly feasible, given a shared vision of the future and a common will to succeed. In summary:

- Inmarsat is well positioned and has enormous strengths and advantages which are particularly important at this time;
- Inmarsat a highly successful organization, with growing markets, revenues and a financially robust balance sheet;
- Inmarsat is now recognized as a global centre of mobile satellite communications know-how and experience;
- Its business integrity is appreciated around the world;
- It has already shown itself to be highly adaptable, moving forward from a "treaty" organization to one which is increasingly commercial. Inmarsat needs to change further but has all of the institutional means needed to restructure and to provide the investment flexibility, and the right governance and management capability to successfully compete in the future;
- Inmarsat members and users benefit from the organization's strong international character and ownership;
- Although Inmarsat operates globally, it acts locally, through its unique structure of signatories and service providers who are close to their markets;
- Any manufacturer anywhere in the world can manufacture and sell Inmarsat terminals, as long as they meet the type approval requirements;
- The Inmarsat system ensures common equipment standards around the world;
- It is here today!

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Competition and Convergence in Canadian Telecommunications

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1. ABSTRACT

Through a series of initiatives over the past five years, Canada has managed the difficult transition from a highly regulated environment to one in which almost all sectors of the telecommunications industry are now open to competition. Moreover, this has been accomplished without jeopardizing Canada's longstanding broadcasting and telecommunications policy objectives, including the provision of universal telephone service at affordable rates and the maintenance of a uniquely Canadian broadcasting policy. As a result, the Canadian regulatory framework provides an alternative model for nations confronted by the challenge of introducing competition and complying with the WTO Reference Paper, while maintaining domestic telecommunications and broadcasting policies.

2.0 INTRODUCTION

The past year has witnessed significant changes in the Canadian telecommunications sector, as steps have been taken to open the last vestiges of monopoly to competition.

Important new initiatives include the following:

(1) introduction of competition in switched local telephony;

(2) introduction of competition in broadcasting distribution using terrestrial, DTH and local multi-point communications systems;

(3) introduction of competitive PCS services;

(4) introduction of price cap regulation for dominant LECs; and

(5) introduction of legislation for licensing international carriers and resellers.

When coupled with prior initiatives to open the public long distance market, the data market and the wireless market to competition, virtually every aspect of telecommunications will be subject to competitive market forces. In addition, the way has been opened for convergence between the broadcast distribution and telephony sectors as new convergence policies permit former monopolists to enter each other's markets.

Given that competition in the provision of public long-distance services was only introduced in mid-1992, the evolution of the Canadian regulatory framework towards competition and convergence has been relatively swift. However, in marked contrast with most countries, where the liberalization of telecommunications markets has been mandated by either government legislation or anti-trust decree, the transition to a competitive framework in Canada has been precipitated in large measure by the CRTC, an independent regulatory agency entrusted with wide-ranging powers to regulate both the telecommunications and broadcasting industries.

This paper explores the CRTC's approach to introducing competition in various market segments, including its approach to such issues as interconnection, anti-competitive conduct and universal service. These are issues which many other countries will now have to address, as they seek to implement the World Trade Organization (WTO) Reference Paper. Canada's experience in seeking to find workable solutions to these problems over the past five years may therefore provide a useful model for others to consider.

Finally, the paper explores recent steps taken by the Government of Canada to fulfill its WTO commitments to open the international telecom sector to competition.

3.0 PRO-COMPETITIVE POLICY IN THE TELECOMMUNICATIONS ACT

Canada's new *Telecommunications Act* came into force on October 25, 1993. It updates in several important respects the antiquated *Railway Act*, that used to govern telecommunications regulation. Perhaps most importantly, section 7 of the Act contains a set of principles which describe the objectives of Canadian telecommunications policy. The CRTC is required to exercise its powers with a view to implementing these policy objectives. The new legislation has a pro-competitive slant which is exhibited in paragraphs (c) and (f) of section 7. These provisions now give the CRTC a clearer mandate to pursue its competitive and deregulatory policies:

(c) to enhance the efficiency and competitiveness, at the national and international levels, of Canadian telecommunications;

(f) to foster increased reliance on market forces for the provision of telecommunications services and to ensure that regulation, where required, is efficient and effective;

Section 34 of the new Act is also important in this regard. This section allows the CRTC to forbear from rate regulation (deregulate) in circumstances that are consistent with Canadian telecommunications policy objectives, where a service is subject to competition which is sufficient to protect the interests of users. The CRTC is not permitted to refrain from regulation of a service when to do so would be likely to "impair unduly the establishment or continuance of a competitive market for that service."

This new power, and the tests for regulatory forbearance which it establishes, now provide the CRTC with the means and an analytical framework to deregulate services or classes of services when competitive market forces are considered sufficient to discipline the telephone companies' pricing strategies.

The restriction on foreign ownership constitutes another important element of the legislation. Canadians must now own at least 80% of the voting shares of a carrier in order for it to be eligible to operate. At least 80% of the Board of Directors must be Canadians and the corporation must not be otherwise controlled by non-Canadians. This 80% requirement has been relaxed somewhat in the case of holding companies that control Canadian carriers. The regulations require that 66 2/3% of the voting shares be held by Canadians in order for the holding company to qualify as "Canadian." In practice, this has led some carriers to have up to 20% foreign ownership at the operating company level and a further 33 1/3% at the holding company level, for a total foreign component of approximately 46.6%.

4.0 PRO-COMPETITIVE INTERCONNECTION POLICIES

Canada has historically had nine regional telephone companies providing services in distinct geographical markets which are usually coincident with provincial borders. Each of these companies is vertically integrated providing both local and long distance services within their respective operating territories. They cooperate with each other in a consortium known as Stentor to provide common national and international services (in conjunction with Teleglobe Canada on overseas calls).

Unlike the situation in the United States, where the antitrust laws and judicial system were used to structurally separate AT&T's local and long distance businesses, the Canadian approach has generally favoured the use of non-structural safeguards to protect against abuses of this vertical structure and, in particular, to prevent the telephone companies from exploiting their control of the local network to advance their position in other more competitive market segments. A number of these approaches to non-structural safeguards are discussed below.

4.1 No "Head-Start" Rules

No "head-start" rules have been used effectively in some instances to encourage the telephone companies, and more recently the cellular and cable television companies, to negotiate competitive access arrangements to their networks in instances where new markets are being opened up to competition. Such rules incent the local access provider to conclude interconnection negotiations in a timely manner since their own ability to enter the new market is tied to their provision of local access to their competitors.

An early example of this approach is provided in the case of cellular telephone service. In 1984, the Government of Canada licensed the regional telephone companies and a competing supplier, Cantel Inc., to provide cellular telephone services across Canada. In order to ensure that the telephone companies could not hold up Cantel's market entry by denying it local network interconnection, the telephone companies' cellular licences were made inoperative until the earlier of two events.

(1) six months following approval of interconnection tariffs or agreements by the appropriate regulator; or

(2) market entry by Cantel.

A similar rule was applied by the CRTC in the case of enhanced telecommunications services and market trials for new services, which rely on underlying local facilities provided by the telephone companies. Generally, the CRTC has not allowed the telephone companies to proceed with either market trials or the launch of new enhanced services unless they have offered, at tariffed rates, the underlying local facilities required by third parties to offer similar trials or services.

More recently, this approach has formed part of the CRTC's convergence policy governing the entry of telephone companies into the broadcasting distribution market. The CRTC has indicated that it will not licence the telephone companies to provide cable TV services until such time as barriers to entry into the local telephony market have been removed.

4.2 Comparably Efficient Interconnection

Generally speaking, the CRTC has required the telephone companies to offer comparably efficient interconnection arrangements to competing service providers. In so doing, the CRTC has invoked its jurisdiction to ensure that the telephone companies do not use their monopoly position in the local exchange market to "confer an undue advantage" on their own operations, or to "discriminate unjustly" against their competitors.

A good example of this approach is found in the CRTC's 1992 decision to permit competitors to offer public long distance (MTS/WATS) services:

> The Commission considers that safeguards should focus on equivalent access to the type of services and facilities that the telephone companies require in order to provide their own long distance services.

This approach led the CRTC to implement an equal access régime for long distance services, whereby subscribers can obtain 1+ dialling to the long distance carrier of their choice on a pre-subscription basis. It also led to the interconnection of CCS7 signalling networks between competing carriers, casual calling arrangements and other features such as busy line verification, barge-in services, directory assistance, billing and collection services, and data base queries/access.

In a later follow-up proceeding in 1994, the CRTC elaborated further on the principles of comparably efficient interconnection in two respects. First, the CRTC endorsed the concept of colocation, which permits competitors to terminate their own transmission facilities on the premises of the central offices (local or tandem switches) operated by the telephone companies. Secondly, the CRTC endorsed the concept of local network unbundling as a means of facilitating efficient interconnection arrangements between competing carriers.

Consistent with this approach to interconnection issues, the CRTC has addressed the issue of access to telephone numbers (including 800 and 900 type numbers) by promoting the establishment of an industry advisory committee composed by industry representatives with recourse to the CRTC in cases of dispute.

The CRTC has also endorsed the concept of local number portability (LNP). It has done so in recognition of the fact that local telephone subscribers (especially business users) would be discouraged from changing suppliers in a competitive market unless they can retain their existing telephone number when they switch local service providers. An industry committee has now been established to pursue technical solutions to the problems associated with LNP. This process is well underway with trials scheduled for early in 1998.

4.3 Restrictions on Unfair Marketing Practices

The CRTC has also recognized that the de facto monopoly enjoyed by the telephone companies in the provision of local switched telephony places them in an advantageous position to know who their competitor's customers are, and when they have switched, or are about to switch, suppliers. This advantage arises from the vertically integrated structure of the telephone companies and the fact that almost all of the customer base still deals with the telephone companies for the provision of switched local telephone services.

This advantage first came under scrutiny in the early 1980's following the introduction of competition in the terminal attachment market. Competing suppliers of PBX and key telephone systems began complaining that when a customer requested a service record, or ordered a cut-over of lines to a competitor's terminal equipment, a telephone company representative would intervene in an attempt to win back the customer.

The CRTC responded to this problem by requiring the telephone companies to set up an independent department to handle these types of orders by competing equipment suppliers. This group of telephone company employees was not allowed to share information received from competitors, with the telephone companies' own marketing divisions.

With the advent of other forms of competitive entry, such as cellular telephone service, resale, the provision of enhanced services and interexchange competition, these groups are now responsible for liaising with a variety of competing service providers.

4.4 Open Network Standards

It is generally recognized that open network standards are required in order for competitive telecommunications markets to develop. This is particularly true in the telecom services and equipment markets where interconnection to the public switched telephone network is required. Use of propriety standards by the telephone companies could otherwise be used to thwart or delay new entry.

In Canada, this issue has been addressed by the CRTC, which has enforced the requirement for open interconnection standards, and Industry Canada, which has worked with industry groups to develop and publish such standards. Standards and protocols exist for terminal equipment, cellular interconnection, interconnection by interexchange carriers and many other forms of services and equipment. In its local competition decisions the CRTC has initiated a process involving industry representatives and CRTC staff to develop all of the necessary technical arrangements required for interconnection of competing suppliers of local switched telephone services.

In addition to policing this requirement for open interconnection standards, the CRTC has required the telephone companies to give formal notice of pending network changes that might affect existing interconnection arrangements with competing service or equipment suppliers. Such notice must be provided at the earlier of the following two dates:

(i) at the time the local telephone company finalizes its decision to proceed with the network change; and

(ii) 6 months before the proposed change.

5.0 RESTRAINTS ON CROSS SUBSIDIZATION OF COMPETITIVE SERVICES AND OTHER ANTI-COMPETITIVE PRICING STRATEGIES

The vertical structure of the regional telephone companies, and the fact that they have historically provided a mix of competitive and monopoly services, posed a significant problem for the CRTC in attempting to prevent cross-subsidization of competitive services and other anti-competitive pricing practices. The CRTC's problems were made worse by the fact that each of the telephone companies had historically been regulated on a rate of return basis with a single rate base for all service elements.

The introduction of competition in certain market segments in the late 1970's and early 1980's began to put considerable strain on this approach to rate regulation. Competitors feared that the telephone companies could lower prices for competitive services and make up for lost revenues on monopoly services which were priced at a level to achieve an allowed rate of return (ROR) on the overall rate base. Later on, with the introduction of long distance competition, the telephone companies' initial dominance in that market gave rise to concerns that they were undercharging in market segments where they faced competition, and overcharging in more inert markets.

In an effort to better replicate a competitive environment for long distance services, and to better police cross-subsidies between local and competitive services, the Commission decided in 1994 to "split" the telephone companies' rate bases into "Utility" and Competitive" segments. The actual split was performed using the CRTC's approved cost separation procedures as the basis for investment allocations between the two segments.

The splitting of the rate base opened the door to separate regulatory treatment of the two segments. Generally speaking, the Utility segment is now comprised of local telephone services, including switched access for competitors. This segment will become subject to price cap regulation in January, 1998.

In order to further address the concerns of competitors regarding the lack of explicit charges for local access utilized by the telephone companies' own long distance services, in 1994 the CRTC required the telephone companies to establish cost-based carrier access tariffs (CATs) to be applied to both the telephone companies' own Competitive segments and their competitors.

As of January 1, 1995, services falling within the Competitive segment, including the telephone companies' long distance services, are no longer subject to either rate of return or price cap regulation. Instead, the CRTC has replaced detailed price regulation with two different types of safeguards designed to prevent targeted pricing strategies and to protect consumers in relatively inert market segments. This has been done by establishing cost-based floor prices for interexchange services and by capping rates for basic (DDD) calls at existing rate levels.

Another important feature of the new split rate base regime was the CRTC's decision to allocate new broadband investment (fibre/coax facilities) to the Competitive segment. The CRTC took this step in part to protect local telephone subscribers from the risks associated with the large scale investment, and in part, to ease concerns as to the potential for cross-subsidization of new multi-media and other competitive broadband services that will primarily utilize the new facilities.

In addition to the pricing safeguards, the CRTC has imposed restrictions on the telephone companies' ability to bundle local (Utility) services with Competitive segment services. These restrictions are intended to prevent the telephone companies from extending their market power in local telephone services to competitive market segments.

6.0 LOCAL COMPETITION

Another major regulatory reform announced in the CRTC's Review of Regulatory Framework decision was its determination to open the local switched telephone market to competition.

In May and June of 1997, the Commission released a group of inter-related decisions and orders delineating the principles for local exchange competition, including interconnection arrangements, network unbundling, co-location, and number portability.

The Commission's Local Competition decision is intended to establish a framework for facilities-based entry by new service providers into the market for local telecommunications services.

There are three important principles which underlie the CRTC's decision:

(1) "Competitive Local Exchange Carriers" (or CLECs) are to be treated as co-

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carriers with the incumbent local telephone companies (or ILECs);

(2) The new regime is "technology neutral"; and

(3) Under the new regime, customers will be assured access to IXCs or wireless carriers of their choice.

The CRTC has chosen an open entry model for CLECs. Anyone can enter provided that they agree to abide by the obligations identified in the decision. Including:

- interconnection with all other LECs, IXCs and wireless service providers;
- equal access for IXCs;
- provision of local number portability;
- access to 911 and Message Relay Service;
- protection of privacy of subscriber information; and
- a variety of information requirements related to consumer protection.

New entrants need only attest to satisfaction of these requirements and notify other carriers and the CRTC of their entry into the market. Once they enter the market, the CLECs' retail rates will not be regulated.

6.1 Local Interconnection Arrangements

Where LECs exchange traffic within an existing exchange boundary, the CRTC has mandated that they connect at a single point of interconnection (unless they agree otherwise). Moreover, the CRTC has mandated that the two LECs share the cost of interconnecting facilities.

Where traffic originates and terminates within an exchange, the CRTC has mandated a "bill and keep" arrangement between LECs provided that there is not a significant traffic imbalance.

6.2 Portable Subsidies

One of the most significant aspects of the new regime relates to contribution payments, or subsidies towards the cost of local telephone service in high cost areas. Interexchange traffic has remained the sole source of this contribution or subsidy. All LECs will collect contribution from IXCs that originate or terminate traffic on their networks. These contribution funds will then be disbursed to all LECs serving residential customers in high cost areas based on the number of residential NAS they serve. In other words, contribution will be portable when a customer switches service providers.

6.3 Unbundling

In its decision the CRTC has mandated the unbundling of a limited number of "essential facilities". These essential elements include:

- central office codes;
- subscriber listings; and
- and local loops in less densely populated areas - principally Bands C + D.

In addition to these "essential facilities", ILECs must also unbundle certain other "necessary facilities" which will be required during the early stages of competition. These include:

- non-essential loops;
- transiting; and
- EAS transport services.

The local competition regime, including the portable subsidy scheme, will be implemented on January 1, 1998.

7.0 MAINTAINING UNIVERSAL SERVICE POLICIES IN COMPETITIVE MARKETS

One of the central issues raised by the introduction of competition in Canadian telecommunications markets has been the potentially adverse impact that competition might have on local telephone rates and policies promoting universal availability of telephone service at reasonable rates.

Historically, local telephone rates have been set at a relatively low rate in Canada to encourage subscription to the telephone system and extend the universality of telephone service in more remote parts of the country. In order to finance this public policy goal, long distance services were historically priced well above cost.

Many of those who opposed the introduction of competition in the long distance and other market segments feared that competition would upset this rate structure and threaten the universal availability of local telephone service at affordable rates.

When the CRTC ultimately permitted competitive facilities-based competition in the long distance market in 1992, it imposed a "contribution" charge on all long distance voice traffic to help offset the cost of providing local telephone services in high cost areas. Later on, this regime evolved to include wireless and data long distance traffic in the category of contribution-paying services.

While this regime has proven to be cumbersome to administer, it has nonetheless served its purpose of minimizing the impact of long distance competition on local rates, in what the CRTC has termed "consumer-friendly competition."

This is not to say that the CRTC has ignored the problems posed by continued subsidization of local service rates. In its 1994 decision respecting the new Regulatory Framework, the CRTC approved the first step in a gradual process of bringing local prices more in line with costs. Since the introduction of long distance competition in 1992, the contribution rate has fallen by approximately 60% and long distance rates have fallen by 30% to 50% in various market segments.

Following its review of the regulatory framework, the CRTC initiated a separate proceeding in 1995 to consider the appropriateness of other mechanisms, such as low cost "lifeline" rate plans, to ensure that local residential telephone service continues to be accessible at affordable rates.

Based on the record of its proceeding, the CRTC made some interesting findings: between 1985 and 1995, the overall price of telephone service (the price of local and long distance services combined) decreased by 44% in real terms; and during the same period, the telephone penetration increased from 98.2% to 98.5%.

8.0 COMPETITION IN BROADCASTING DISTRIBUTION

On October 11, 1994, the Government of Canada initiated a broad-based inquiry by the CRTC on the policy and regulatory implications of the convergence of the broadcasting and telecommunications industries.

In its discussion of "background principles" the Government emphasized the need to ensure competition through the establishment of a level playing field across sectors and groups of competitors.

The Government went on to request the CRTC to address the specific question of whether it would be appropriate for all telecommunications carriers to become eligible to hold broadcasting licences and if so, within what timeframe and under what conditions.

In its report entitled "Competition and Culture on Canada's Information Highway: Managing the Realities of Transition" (19 May 1995) (the "Convergence Report") the CRTC determined that in order to achieve the goal of competition, telephone companies should not be granted broadcasting licences until the many barriers to entry into the local telephone market had been removed.

In August, 1996, the Government formally endorsed this "no head start" rule in its "Convergence Policy Statement."

> To ensure fair competition and no head starts, the Commission should ensure that telephone companies cannot offer their broadcasting distribution services until regulatory barriers to competition in local telephone service have been removed and the Commission has approved tariffs to enable cable companies and others to launch

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competitive local services. This may be done on a market by market basis.

The CRTC's recent decision on local competition, and its related proceedings on local number portability, colocation and unbundling are designed to remove the existing barriers to entry into the local telephony market. Once all of these barriers are removed, which is expected sometime in 1998, the Stentor companies will be permitted to enter the broadcasting distribution market in competition with the cable television companies, DTH service providers and other service providers in that market.

In addition to permitting the telephone companies to enter the broadcasting distribution market the CRTC has taken a number of steps in the past two years to open the broadcasting distribution market to competition.

For example, in 1996, the CRTC licensed Pacific Place Communications to provide the first competing cable television service within the existing operating territory of a long-established cable television company - Rogers Cable T.V.

In that same year, Industry Canada issued frequency blocks in the 28 GHz band to provide competitive telecommunications and broadcasting distribution services using Local Multipoint Communications Systems (LMCS).

Since 1995, the CRTC has also licensed a number of carriers to provide direct-to-home (DTH) satellite-based broadcasting distribution services in the Canadian market.

Steps have also been taken to open up access to existing cable television distribution networks to competing suppliers of telecommunications services.

One of the first markets to become subject to the forces of competition between cable television companies and telephone companies is the Internet access market. In 1996, the cable television industry launched a new high-speed Internet access service called the WAVE employing its local broadband distribution network. Earlier in 1996, the telephone companies had initiated their own Internet access service called Sympatico. In both instances, the CRTC is requiring that non-discriminatory network access be provided to third party Internet service providers.

9.0 INTERNATIONAL DEVELOPMENTS

At the present time, Teleglobe Canada still enjoys a monopoly in the provision of overseas telecommunications services originating or terminating in Canada.

This monopoly is enforced in a number of ways including a refusal by the Government of Canada to licence other overseas carriers, or grant landing right to such carriers, as well as the imposition of routing restrictions on Canadian carriers and resellers designed to prevent by-pass of Teleglobe's facilities by routing overseas traffic through the United States or by switching Canadian traffic through "hubs" in other countries.

The switching of Teleglobe's private line services in Canada by resellers is permitted where reciprocal rights exist in the correspondent country.

However, this restriction and the restriction on hubbing severely limit this form of competition.

The CRTC's restrictions on by-pass of Teleglobe's facilities and on hubbing have been the subject of considerable dispute over the past two years. On May 5, 1997, the CRTC issued a decision which permitted facilities-based carriers, including the Stentor companies, to engage in international simple resale to countries offering reciprocal rights. However, the CRTC reconfirmed its restrictions on bypass and third country hubbing.

The CRTC's decision to retain its restrictions on hubbing has since been the subject of litigation and a proceeding has been convened by the CRTC for reconsideration of its decision.

The CRTC has also announced its intention to consider a new framework for competition in the provision of overseas telecommunications services early in 1998 and, on October 31, 1997, legislation was introduced in Parliament to create a new licensing regime for international carriers and resellers.

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Consistent with Canada's commitments to the WTO agreement on Basic Telecommunications, the new legislation does not contain any restrictions on ownership of international carriers.

Services regulated under the *Broadcasting Act* and measures affecting such services, as well as telecommunications services supplied for the transmission of services regulated under the *Broadcasting Act* "where such services are intended for direct reception by the public", are expressly excluded from the services covered by Canada's schedule of specific commitments.

In very general terms, under its schedule of specific commitments on basic telecommunications, Canada has committed to the liberalization of its routing restrictions:

(1) as of January 1, 1998, there will be no restrictions on routing of mobile satellite services between points in Canada and between points in Canada and the United States;

(2) as of October 1, 1998, all restrictions on routing of mobile satellite services will be lifted;

(3) as of December 31, 1999, restrictions on routing of international services (other than fixed satellite services between Canada and points in the United States) will be lifted; and

(4) all restrictions on routing of satellite services will be lifted on March 1, 2000.

With respect to ownership, the general restrictions on foreign ownership of facilities-based service providers remain in place. Canada did, however, commit to the following changes in the current ownership regime: foreign ownership restrictions for mobile and fixed satellites used to provide services in Canada are lifted in parallel with the removal of traffic routing restrictions for these services; and as of October 1, 1998, foreigners will be permitted to own up to 100% of international submarine cables landing in Canada.

Canada has also committed to end the monopolies held by Teleglobe and Telesat. Teleglobe's monopoly on Canada-overseas services will end on October 1, 1998. Telesat's monopoly on fixed satellite services will end March 1, 2000.

10.0 CONCLUSIONS

Based on a review of the Canadian experience, it is clear that involvement of the regulator is required in managing the transition from monopoly to competition in integrated telecommunications markets.

Absent the type of structural separation and divestiture witnessed in the United States, considerable regulatory effort is required to negate the ability of the incumbent to provide discriminatory access to its competitors; to prevent the cross-subsidization of the incumbent's own competitive operations and to prevent anti-competitive pricing practices from being pursued in horizontal competitive markets where the incumbent may still retain market power.

In Canada a number of mechanisms have been used to promote competition in both the telephony and broadcasting distribution markets, while at the same time ensuring that long-standing domestic policy goals continue to be pursued.

These mechanisms should be of interest to other countries seeking to implement the terms of the WTO "Reference Paper."

In addition, steps have been taken to ensure that in areas of convergence like the broadcasting distribution section, new entry by telephone companies is coincident with the removal of barriers to entry into their own local telephony markets. The removal of these barriers is underway and will be achieved in 1998.

On the international front, steps are being taken to open the overseas market to competition. By October 1, 1998 the overseas market will be open to competition with a new licensing regime in place.

Regulating for Convergence – Asian Issues and Conflicts

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1. ABSTRACT

This paper provides an overview of initiatives taken in Singapore, Malaysia, People's Republic of China, Hong Kong and Indonesia in relation to convergence and the regulation of convergence. All countries under examination have formulated policies to deal with the information infrastructure, but the strategies for implementation differ from country to country.

2. INTRODUCTION

The most important communications issue facing the majority of countries in Asia-Pacific is still how to increase telephone penetration levels, so as to provide affordable plain old telephone services (POTS) to all sections of the community.

Recently however, many countries in Asia, as elsewhere, have developed initiatives for the establishment of an information infrastructure at national or regional levels to provide 'pretty amazing new services' (PANS). In addition, supra national organisations are considering the development of the global advanced information infrastructure.

The existence of a well established, ubiquitous and pervasive telecommunications network is understood to be an essential pre-requisite for establishing an advanced information infrastructure. In contrast to the situation in Asia-Pacific, the advantage which a number of the western developed economies have is that such telecommunications networks were already in the process of being established by the 1980s. Furthermore the early introduction of competition in such countries has provided them with the experience of regulating the telecommunications industry in an emerging competitive environment. The perceived success of deregulation in the telecommunications industry and the benefits that the introduction of competition has brought about in terms of greater choice, improved quality of services and lower costs, means that market forces and competition are viewed as the essential mechanisms for the implementation of an advanced information infrastructure.

In contrast, Asian governments have only just started tackling the issues associated with the deregulation of telecommunications and the introduction of competition (in varying degrees) in order to promote the growth of telecommunications services. Nevertheless, confronted with the technological and societal revolution presented by the imminent advent of the information age, Asian countries are keenly aware of the possibility of leap-frogging technologies and ensuring that their citizens are not left behind. In this context, in September 1996 the Asia-Pacific Telecommunity organised its Second Policy Meeting on the Asia-Pacific Information Infrastructure ("AII") in Thailand. This was followed by a high level Development Meeting on AII in June 1997 also in Thailand.

Notwithstanding the open declaration of the Asia-Pacific governments, set out in the Seoul Declaration for the Asia-Pacific Information Infrastructure in May 1995, that one of the core principles for the development of the Asia-Pacific information infrastructure would be the promotion of a competitive environment, the interpretation of competition across Asia-Pacific seems to vary markedly. This seems to arise not from a difference of opinion as to whether a competitive model is the best model, but rather which path will best lead to a competitive model appropriate to a given nation.

This paper attempts to provide a brief overview of the steps which are being taken in several countries in Asia in order to implement an advanced information infrastructure and how issues of regulation and competition are being addressed, if at all, at this stage.

3. THE WESTERN EXPERIENCE

3.1 *Initiatives*

Western economies with high telephone density levels are in the process of developing strategies for the implementation of advanced information infrastructures, such as the launch of the US National Information Infrastructure Initiative. In the UK the government has already begun addressing the economic, social and technological issues raised by converging technologies for the delivery of information. In 1994 the Trade and Industry Committee report *Optical Fibre Networks*(1) and the Government Command Paper *Creating the Superhighways of the Future: Developing Broadband Communications in the UK*(2) advocated the timely implementation of networks capable of conveying broadband services. The UK telecommunications regulator, Oftel, issued a consultative document in August 1995 entitled *Beyond the Telephone, the Television and the PC*(3) setting out the initial parameters for the regulation of broadband switched mass market (BSM) services with a view to stimulating debate in the industry as to the appropriate regulatory action. Oftel is still considering the responses.

In the European Union, the European Commission will soon launch a consultation on the policy implications of convergence through the publication of a Green paper The Convergence Green Paper of 1997 (which was due for publication in November 1997 but appears to have been delayed) is intended as a platform for defining the policy response in the EU in respect of convergence over the next five years. The European Commission has also suggested that the next step to simplify the current framework would be to create a "European Communications Act" which would bring together legislation on the provision of infrastructure, services, content and the conditions of access to content.(4) This proposal echoes the strategy proposed to be adopted by Malaysia through the Multimedia Convergence Act which is discussed below.

3.2 *The Competition Paradigm*

The experience of developed economies such as the US, UK and Australia in revolutionizing the telecommunications industry with the introduction of competition has created a precedent for the regulatory action to be implemented for broadband services. The remarkable success achieved over the last decade in bringing costs down, creating greater choice and improving services in the telecommunications sector through the introduction of competition have created a mindset for the development of an advanced information infrastructure. Competition is viewed as the ultimate driver for the implementation of broadband networks.

The corollary of the introduction of competition has been a reliance on competition law principles to regulate and control the dominance of the incumbent operator. Accordingly the focus of the thinking for the regulation of broadband services has been how to encourage investment in such services whilst at the same time putting in place the necessary controls and checks to curb the emergence of a dominant player that may have the market power to stifle or distort competition.

For example, in the UK, Oftel has publicly stated that in respect of broadband switched mass market services, it would not seek to regulate for the sake of regulation and only a minimal level of regulation would be imposed, leaving the market to decide on most issues. Regulation would be implemented only to the extent necessary to promote the development of the market, to protect the consumers and to safeguard the interests of new entrants.(5)

Oftel has identified the ownership of distribution networks as the most likely area where dominance may arise. Clearly dominance could emerge in other areas of the advanced information infrastructure, particularly in the area of content provision, but Oftel is of the view that sustainable dominance is only likely to exist in this area where control of content provision is integrated with control or ownership of distribution networks.(6) Oftel has therefore proposed that where distribution network owners achieve market dominance (based on criteria which have been developed under the European Union's competition law policies) regulation would seek to achieve the following aims.

- Open access for service providers (including network owners) on a non-discriminatory basis;
- Allowing direct commercial relationships between service providers and individual customers, allowing the former to set their own retail prices;
- Appropriate separation between network distribution and service provision;
- Open technical standards and interfaces at the network termination points to allow implementation of open access and competition in the supply of consumer premises equipment.(7)

In Australia, the recent amendments to the Telecommunication Act are similarly focused on competition law as a means of curbing market dominance, but allowing market forces to ensure the deployment of broadband networks. The former telecommunications regulatory authority AUSTEL has been abolished and replaced by the general competition law regulatory body, the Australian Competition and Consumer Commission.

This brief outline does not mean that the western developed economies are not considering other areas that need to be addressed. For example, interconnection is clearly an operational matter that impacts on the viability of competition in the provision of distribution networks. Other areas are also being addressed such as copyright protection, protection from inappropriate content on the internet, protection from tampering of communications and protecting the safety and security of communications. However the basic question in relation to competition remains to what extent the regulatory policies implemented for the introduction of competition in the telecommunications sector can be applied to broadband services. As Oftel concludes in its consultative document:-

"we want to adapt the successful policies of the narrowband switched world - such as promoting competition and regulating dominant and non-dominant systems on a different basis - for the broadband switched world." (8)

4. SINGAPORE

4.1 *Initiatives*

On the basis that the next century will depend on information and knowledge as the main driver for growth, in March 1992 the Singapore National Computer Board announced the IT 2000 vision under which Singapore is to be transformed into an intelligent island with an advanced information infrastructure connecting computers in every home, office, school and factory. In 1996, as a major step in the realisation of IT2000, the Singaporean Government launched the initial stages of the deployment of a multi media broadband network (MBN) which is known as "Singapore ONE" (One Network for Everyone). The infrastructure of Singapore ONE has a core broadband network based on ATM switching and optical fibre technologies connecting several local access networks which will link businesses, schools and homes. Singapore ONE is currently being implemented as a joint project driven by the Telecommunication Authority of Singapore (TAS), the National Computer Board (NCB), the National Science and Technology Board (NSTB), the Economic Development Board (EDB) and the Singapore Broadcasting Authority (SBA). Given the regulated nature of Singapore's executive structure, the institutional co-ordination of Singapore ONE has been carefully crafted with a relative absence of overlapping spheres of competence often seen in Asian countries.

ÿ TAS, the telecommunications regulator, is responsible for licensing and driving infrastructure development.

ÿ The NTSB is responsible for encouraging research and development in new technologies and new services on Singapore ONE.

ÿ The NCB spearheads the execution and delivery of applications and services on Singapore ONE.

ÿ The EDB, which has overall responsibility for industrial planning, is involved in promoting the development of on-line businesses and encouraging electronic commerce.

ÿ The SBA which regulates the broadcasting industry, is involved in encouraging the creation of content for Singapore ONE.(9)

Under Singapore ONE, a number of broadband testbeds are currently under trial. Singapore Telecom has embarked on a video on demand (VOD) system trial based on both ADSL and fibre-coaxial access network technologies. There is island wide coverage for the provision of ADSL supported services (e.g. fast internet access).

A fibre optic high speed testbed based on ATM switching is currently in place at the Science Park, linking research and development institutions such as the Information Technology Institutes (ITI), the Institute of System Science (ISS) the Singaporean Universities and Singapore Telecoms optical network for experimentation and development of advanced information technologies and broadband applications.

The Singapore Government has promoted the construction of a cable TV network by Singapore Cable Vision (SCV) and SCV is currently deploying a nation wide cable TV network with a target of 800,000 households to be passed by 1998. SCV has the advantage of mandated access to the optic fibre network which it leases from Singapore Telecom. SCV is responsible for the construction of the vertical network by linking coaxial cable to the optic fibre network to connect all homes in high rise residential buildings and landed dwelling units. As such, SCV's network would provide a coaxial connection from homes to the information super highway until fibre is deployed to the home.(10)

4.2 *Regulatory Approach*

The interesting aspect of Singapore's model is that while the Government has a policy of liberalisation in the telecommunications industry (driven in part by its WTO obligations), the philosophy in Singapore is one of introducing competition progressively. In practice this reflects the Government's view that the development of a nation wide broadband infrastructure would not be rapid and efficient if left purely to market forces. The argument is that as there is as yet no proven commercially viable broadband application and since Singapore Telecom and SCV are private entities (although the Government is a significant stakeholder), their investment decisions would largely be influenced by profitability. In such a scenario it is arguable that commercial operations would be unlikely to make the necessary investment. In practice therefore the Government is underwriting part of the investment cost of the physical network by guaranteeing some minimal level of usage to the network provider. The capacity leased by the government will be used to make government services available to the public via the MBN.

The net result of this regulatory approach appears to be one of top-down government driven impetus. The government is providing fiscal and financial incentive schemes, such as the Singapore ONE Pioneer Club, where businesses launching a commercial application or service by 30 June 1998 enjoy special funding schemes, tax incentives programmes, preferential tariff rates and publicity programmes. Unlike many other Asian countries there is a clear division of labour between the Government agencies and their activities are co-ordinated by the National IT Committee. Furthermore, competition in the provision of infrastructure has been sanctioned by the proposal to issue up to two licences for basic services starting in the year 2000. However as yet there has been no formal policy statement as to how Singapore Telecom's dominant position is going to be regulated in a competitive broadband environment. This is a knotty issue which the Singapore government has chosen not to address yet.

5. MALAYSIA

5.1 *Initiatives*

As part of the Vision 2020 initiative$^{(11)}$, the Malaysian Government aims to create a knowledge based society where all Malaysians will have access to information and learning through telecommunications and multimedia infrastructure for personal, organisational and national advancement. The former monopoly telecommunications provider, Telekom Malaysia Berhad (TMB), was partially privatised in 1990, since which competition has been gradually introduced as part of the Governments strategy to achieve rapid advancement. At present there are four principal fixed line competitors to TMB as well as a number of wireless operators.

TMB has been encouraged to roll out its network so that all areas of Malaysia are reached. It is reported to have approximately 13,000 kms of fibre optic cable, and is expanding its investment in fibre in the local loop. In 1996, a joint venture was established between Telekom Malaysia and Permodolan Nasional to establish a network for government agencies.

Other carriers are also commencing optic fibre network roll out, in particular Time Telekom, with its extensive optic fibre trunk network along the North - South Expressway.

5.2 *Multimedia Super Corridor*

The Multimedia Super Corridor (MSC) is an area of development 15 kms by 50 kms long which will span an area from the Kuala Lumpur city centre, south to the new Kuala Lumpur international airport. The MSC is the focal point of the Government's development of multimedia services in Malaysia. Launched in 1996, the MSC is intended to act as a test-bed for the development and application of leading-edge technologies. Two cities are being developed in the MSC being Putrajaya (to be the site of the new Government and administrative capital) and Cyberjaya (the intelligent city).

Companies awarded MSC status will enjoy certain financial and non-financial benefits such as tax incentives, research and development grants and special telecommunications tariffs. The Government has targeted seven multimedia applications for development by the year 2000. These include electronic government, telemedicine, a multipurpose card and borderless marketing centres.

5.3 *Regulatory Approach*

Many have argued that the Malaysian regulatory framework has not kept pace with the pace of competition so as to provide an environment of certainty of investment for the new infrastructure based carriers. This is probably in part due to the inherent conflict between the functions of the regulatory body (Jabatan Telekom Malaysia or JTM, which is a government department) and the government's stake in Telekom Malaysia. It is also in part due to the high level of discretion exercised by JTM.

There are various examples of the slow pace of regulatory liberalisation. While a framework on interconnection and access has been promulgated by the Government[12], the framework has given rise to several areas of concern. For example, interconnect charging has been based on revenue sharing rather than cost. The Government has delayed the introduction of equal access for long distance and international communications. Both of these issues have concerned the new fixed network carriers and reduced revenue available for investment.

It is not yet clear how the Government will regulate the information infrastructure and related services.

There has been some indication that the Government may limit the application of principles of open access and interconnection in the broadband environment. For example, in the MSC, the Government proposes to grant to Telekom Malaysia the exclusive right to supply telephony and leased line services to all customers in the MSC area at levels up to the ATM switch level. This has been justified on the basis of the large amounts of investment required in order to complete the MSC infrastructure. It highlights a difficulty inherent in the regulation of the broadband environment. That is, while it may be considered necessary to grant exclusive rights to encourage infrastructure investment, to do so may give rise to the same inefficiencies and lack of incentive for innovation and investment which characterised previous monopolies in narrow band environments.

Nevertheless, Malaysia is one of the first countries in the world to develop a scheme of legislation intended to meet the particular needs of convergence. New combined legislation to be known as the *Multimedia Convergence Act* will govern telecommunications, broadcasting and on-line services and will replace existing telecommunications and broadcasting legislation. The passage of this legislation has been deferred and is now expected to take place early in 1998

Although details of the new legislation have yet to be released, the Government is expected to encourage facilities based competition and to implement competitive safeguards for the converged sector. It is believed that the Government will only impose individual licensing for facilities based services provided for the public. Non-facilities based services and services not intended for the public, such as closed user groups, will either not require a licence or will be subject to a class licensing scheme. It is also believed that content for interactive and on-line services will not be regulated under the new Act, but will be governed by other legislation, such as the rules in relation to censorship, defamation, copyright, etc

Certain legislation of interest has already been passed. The first four *Cyberlaws* have been passed by the Malaysian parliament - the Digital Signature Act, the Computer Crime Act, Amendments to the Copyright Act, and the Telemedicine Act. A review of this legislation is beyond the scope of this paper. However, the passage of this legislation and the proposals for further legislation emphasise the seriousness with which the Malaysian Government is treating issues associated with the information age.

6. CHINA

6.1 *Initiatives*

6.1.1 General

The Chinese government has set the year 2010 as the target date to have in place a state-of-the-art communications system that would include, among other things, a broadband, integrated communications network linking major cities throughout the country and supporting a range of multimedia and data communications services. This is clearly an ambitious goal given that China is still developing the infrastructure required to provide even relatively basic telecom and broadcasting services on a nationwide basis.

While domestic competition with the dominant state player, the Ministry of Post and Telecommunications (MPT), is on the up-swing, no clear-cut policies have yet to emerge as to how China plans to meet the challenges presented by technological convergence. Complicating China's efforts to develop policies in this regard are the on-going ministerial power struggles, the PRC government's censorship concerns and mounting international pressure to open the telecoms markets in accordance with WTO requirements.

With such a multitude of factors at play, it is therefore difficult to predict the regulatory approach that will be taken in China, but we set out some of the initiatives that are being taken to indicate the problems which China will need to address at a later stage.

6.1.2 Dominant Player - Ministry of Post and Telecommunications

As the regulator of the telecommunications industry, the MPT controls interconnection with all local and international service networks and thus, can (and does) wield significant influence over any third party's implementation of network projects. Having completed in 1996 a long-distance backbone consisting mainly of fibre optic cable and supplemented with microwave and satellite links that connects 30 provincial capitals and major cities, the MPT has by far the biggest existing network in China.

Operating under the MPT, the Data Communications Bureau (DCB) administers China's public data communications networks. The DCB has recently completed a frame relay backbone and supervises both ChinaNet, China's main Internet backbone, and ChinaPac's national packet-switched network which went into operation in 1993. Outdated infrastructure in parts of the MPT network and sporadic service has, however, made local access to these services extremely unreliable. Although a separate MPT department is making moves to offer ISDN services, high installation rates and the use of incompatible ISDN switches throughout China will likely retard progress in that regard.

6.1.3 Other Players

Unicom, a cooperative structure comprising of the Ministry of Railways, Ministry of Electronics Industry and the Ministry of Power, along with 13 other major shareholders, has, since its establishment in 1994, mounted an impressive challenge to the MPT's monopoly in mobile services. Unicom has recently announced that it will offer fixed line services in Tianjin and Chongqing, as well as develop a long distance network consisting of 5,000-km of fibre optic cables. Unicom has also teamed up with the technology firm Sparkle to operate an Internet database offering State Council-supplied information on one million Chinese companies.

A third telecom operator, Jitong Communications Co. Ltd., is expanding China's information technology infrastructure through a series of deals known as the Golden Projects. Both Jitong, which is licensed to provide data services including Internet access, and the Ministry of Radio, Film and Television (MRFT), which operates an extensive cable network, will no doubt figure prominently in the emergence of multi-media communications services in China. In fact, recent reports indicate that Unicom has joined forces with Jitong and MRFT to use hybrid-fiber-coax (HFC) technology that would provide voice, data and video over existing cable infrastructure.

Foreign companies are specifically banned from managing and operating telecoms networks or investing in cable networks, however, this is not to say that foreign companies are not playing an active role in the developing PRC telecoms market. To that end, more and more foreign companies are teaming up with PRC entities to install networks with equipment. Some foreign companies are also seeking to skirt the ban on foreign participation in the operation of networks by characterizing their services to network operators as "consulting" and utilizing what some would consider relatively "creative" investment structures. Prodigy's formation of a joint venture with China North Industries or Norinco to become the first government-approved foreign Internet provider, also indicates a further area in which ambiguity under PRC law may provide an opportunity for foreign investors.

6.2 *Regulation*

6.2.1 Converging Technologies: Competing Bureaucracies

Whether multimedia will be subject to telecommunications or broadcasting regulations is inextricably linked with the relative powers of the two Ministries in these sectors, namely the MPT and the Ministry of Radio, Film and Television (MRFT). Between the MPT and the MRFT, MRFT is arguably in a weaker position given that it does not have authority to provide data or voice services or the funds required to independently upgrade its network. MRFT's alliances with Unicom and Jitong, will, however, no doubt enhance its position in this regard. The MPT also has somewhat of a head start in the multimedia arena given its leading role as an Internet service provider and in the area of data services.

The Ministry of Electronics Industry, the State Education Commission, as well as the Public Security Bureau are also involved with China's information technology industry. Moreover, on a macro-economic level, the Leading Group on Information Advancement, which is comprised of representatives of nearly 20 governmental bodies and reports directly to the State Council, is responsible for developing policies in the information technology industry. While the Leading Group has offered some unified guidance amidst the ministerial jousting, it has yet to break the MPT's virtual monopoly or provide comprehensive guidelines as to how China plans to meet the challenges of establishing nationwide state-of-the-art communications services. It is possible that more streamlined policies may emerge when the long awaited new telecommunications law is promulgated (although it remains to be seen when the law will be finalized and issued). It is also worth noting that shake-ups at the ministerial level are rumoured with one proposal apparently under consideration being the creation of a State Commission for Information that would be responsible for formulating policies with regard to licensing, resource allocation as well as national standards. This new commission would coordinate between the MEI and the MPT and would likely introduce a new licensing system for multi-media, convergence type technologies.

Notwithstanding the ambiguity that exists with respect to the supervisory authority over multimedia, it is reasonable to expect, given how the Chinese government has introduced reforms and innovations in other industries, that multimedia services will in the future be licensed and introduced on an experimental basis in a limited number of cities. Following an assessment of these trial programs, national regulations would likely be developed.

6.2.2 Regulation of the Internet- Piecemeal Approach

China's approach toward regulating Internet services reflects the Chinese government's ongoing struggle to permit services that are required for an integrated, internationally viable economy while at the same time maintaining strict censorship control. To that end, regulations regarding Internet use and services have been introduced in a piecemeal approach often in response to, rather than in anticipation of, the introduction of high end technologies.

The primary legislation in this regard is the *Provisional Administrative Regulations of the PRC on International Connections to Computer Information Networks* (promulgated 1 February 1996, by the State Council) ("Provisional Regulations") and the *Decision of the State Council on Amendment of the Provisional Administrative Regulations of the PRC on International Connections to Computer Information Networks* (Promulgated May 20, 1997, by the State Council). The Provisional Regulations require that Internet users register with the police and ban the transmission of state secrets, information harmful to state security and pornography. Under revisions to the Provisional Regulations effective May, 1997, units engaging in business activities related to global computer networks must now apply for licenses and provide data on the nature and scope of their networks, as well as the addresses of their computer hosts. Only four entities or Internet service providers (or IPSs) are authorized to provide international Internet access in China: ChinaNet (which is operated by under the MPT arm DCB and is the country's principle commercial service provider), the Golden Bridge Network (operated by the Ministry of Electronics Industry through its subsidiary Jitong), Chinese Academy of Sciences Networked and the China Education and Research Network. There are more than 100 secondary commercial Internet providers.

While the Chinese government appears committed to developing an integrated high speed information network, it remains to be seen how interaction with foreign links will be managed. In the past, China has, for example, temporarily blocked access to more than 100 Wed sites, including the Web page of the Wall Street Journal and several other well-known Western news providers. The Chinese government is also developing a nationwide intranet, complete with filters to control access to (and from) the network.

7. HONG KONG

7.1 *Initiatives*

While Hong Kong is now a part of the People's Republic of China (PRC), the regulation of the telecommunications industry does not reflect that which exists on the mainland. The basic law which has governed Hong Kong since 1 July 1997 promises that the "laws previously in force in Hong Kong ... shall be maintained after 1 July 1997 and that the "previous capitalist system and way of life shall remain unchanged for 50 years". Thus far, there has been no indication that this will not be adhered to in the regulation of the telecommunications industry.

Until July 1995, the Hong Kong Telecom Group, through Hong Kong Telephone Co. Ltd. (HKTC), held an exclusive franchise over the provision of domestic fixed network telecommunications services in Hong Kong. In July 1995, three new fixed telecommunications network service (FTNS) operators were licensed to compete with HKTC in relation to FTNS services.

Hong Kong's telecommunications network is very advanced. HKTC is reporting to be planning to spend over $10 billion over the next 10 years to establish a broadband services network in Hong Kong(13). Further, the subsidiary of the Hong Kong Telecom Group which has been established for the purpose of delivering multi-media services is reported to be proposing to spend a like amount to provide intelligent service platforms and customer equipment.

The new FTNS operators are also in the process of investing in optic fibre backbone facilities. In the local loop, the new operators are either establishing their own fibre facilities, principally in business areas, or leasing capacity from HKTC.

Wharf Cable Limited has the exclusive right to provide terrestrial subscription television services until 1998. Wharf Cable Limited is an affiliate of one of the new FTNS operators, New T&T Hong Limited. New T&T has access to additional broadband infrastructure through access to the Wharf Cable network.

The Government announced earlier in the year that it would licence two video on demand (VOD) service providers. The first of these new VOD licences has been issued to an affiliate of HKTC, Hong Kong Telecom IMS Limited. The process for the issue of the second licence has been held up pending resolution of a legal dispute affecting two of the licence applicants. These licences are non facilities based programme service licences, with the transmission facilities to be provided by the new FTNS operators. HKTC will provide VOD transmission facilities through a combination of fibre, co-axial cable and where necessary copper wires utilising ADSL technology.

7.2 *Regulatory Approach*

7.2.1 Policy

In his policy address of 8 October 1997(14) the Chief Executive of the Hong Kong Special Administrative Region, Mr. Tung Chee-hwa, foreshadowed policies intended to make Hong Kong a leader in the information world, including the bringing together of:

- hardware of high capacity communications systems;
- a common software interface through which individuals, business and government can interact easily and securely use their own systems;
- people who know how to use the new technology; and
- a cultural environment that stimulates creativity and welcomes advances in the use of technology.

A Bureau Secretary is to be established to co-ordinate overall information technology development in Hong Kong. This is an important step for Hong Kong as to date, the authorities responsible for broadcasting and those responsible for telecommunications have operated with only a minimal amount of co-ordination.

The policy address also foreshadowed that steps will be taken to introduce information technology measures in education, including connection of all schools to the internet and making preparations for an education specific intranet.

7.2.2 Information Infrastructure Advisory Committee

In March 1997, an Information Infrastructure Advisory Committee (IIAC) comprised of various interested parties was established to advise the Office of the Telecommunications Authority (OFTA) on aspects of the development of the information infrastructure in Hong Kong, including technical and regulatory issues.

7.2.3 Regulatory Approach Existing Regulation

Strong dominant carrier controls are in place in relation to the conduct of the incumbent carrier HKTC in the narrow band environment. The measures which have been taken include:

- cost based interconnect charges(15);
- the availability of *type II* interconnection(16) (similar to expanded access interconnection as it is known in the US) enabling new competitors of HKTC to gain access to HKTC's local loop on an unbundled basis;
- restrictions on anti-competitive conduct contained in the licence conditions, with specific restrictions applicable to anti-competitive conduct by carriers possessing dominance;
- the tariffs of HKTC are subject to the approval of the TA and HKTC may not give discounts to its prices without the approval of the TA.

In July 1997, OFTA confirmed that it intends to continue to rely on dominant carrier regulation in respect of video on demand services. As HKTC is regarded as the dominant operator, transmission services provided to its affiliated company providing VOD services will have to be tariffed and applied to all VOD programme service providers on a non-discriminatory basis.

Broadband Regulation

One of the key issues currently being addressed in Hong Kong is whether the regulatory framework which applies in the narrowband environment will be extended to the broadband environment.

Vigorous debate has already commenced as to whether HKTC's broadband network should be subject to existing regulations. Predictably, HKTC has argued that it is not necessarily dominant in relation to the broadband market, and that broadband and narrow band services should be regulated separately.

As noted above, in the context of video on demand, OFTA has continued to adopt dominant carrier regulation to the transmission services provided by HKTC. However, the Telecommunications Authority (TA) has taken the view that regulation ought to reflect the risk involved in investment in broadband networks.

The TA has decided against mandating Type II interconnection (see above) to the broadband environment for a period of three years from commencement of relevant services.(17)

OFTA has identified the types of infrastructure where a Type II determination will not be made in relation to broadband services. Essentially they are elements of the access network which constitute bottlenecks. They are:

ÿ optical fibre cables from local exchanges to equipment rooms and buildings (basically fibre to the curb);

ÿ copper cables within buildings between equipment rooms to the customer premises where such cables are newly installed for broadband conveyance services provided that there are copper cables available for telephone services (which would therefore be available for Type II interconnection for telephone services); and

ÿ electronic equipment for the conveyance of broadband services, since electronic equipment can readily be provided by competing operators.

Hong Kong therefore appears to be taking the UK approach which identifies those areas of the narrowband regulatory regime which seem applicable to a broadband environment, but at the same time do not (for example because of the dominance of a particular operator) inhibit investment by operators by allowing the competitor to "piggy back" on infrastructure investments made by a particular operator.

8. INDONESIA

8.1 *Broadband Initiatives*

In November 1996, the Government of Indonesia announced the promotion of the *'Nusantara 21'*(18) initiative under which Indonesia aims to develop an advanced information infrastructure for the 21st century. In January 1997 the Minister of Tourism, Post and Telecommunications issued a document entitled *'Network and Information Systems: Nusantara 21'* which sets out a masterplan for the development of broadband applications and services in Indonesia. The masterplan does provide some detail as to the areas which are to initially be served by broadband networks and in this sense mirrors the Malaysian concept of the Multimedia Super Corridor. However the document is drafted in general terms setting out the eventual goal of connecting the citizens of Indonesia to the information superhighway, but does not provide any detail as to the means by which this is to be achieved, nor does it provide the outline of the regulatory framework that might be imposed.

Six months ago PT Telkom, the Government backed telecommunications operator announced that it would invest US$100 million in PT Multimedia Nusantara, a company which is also backed by the state broadcaster TVRI, the satellite services operator PT Indosat and PT Indocitra Grahabawana. The latter company has an 'in-principle' licence to provide multimedia services. PT Indovision, a cable and satellite operator is also moving into the field of the provision of multimedia services.

In addition, PT Pasifik Satelit Nusantara is planning the launch in late 1998 of the M2A 'multimedia' satellite. The M2A satellite has been designed to distribute internet, interactive video services and rural telephony. It faces competition from PT Satelindo's Palapa D project, which is the latest of the Palapa series satellites. This is planned for launch in 1999 and is for internet and DTH service applications.

8.2 *Regulatory Framework*

The conflict between the Ministries responsible for telecommunications and media respectively which is evident in China, is equally present in Indonesia.

The Ministry of Tourism, Posts and Telecommunications presides over a regime for telecommunications which is considerably more liberal than the Information Ministry responsible for television and other forms of media. This is particularly evident in the area of foreign investment, where investment has been permitted subject to equity limits in the telecommunications field, but not in the media area. Similarly, even where foreign investment in telecommunications is more restricted such as in the fixed network area, foreign interests have been permitted to participate through the successful KSO (joint operating scheme) projects.

Although the Indonesian government recently passed a new broadcasting law(19), this has not effectively dealt with the regulation of convergent technologies. 'Multimedia' is referred to in passing in the new broadcasting law as being provided by so-called 'Special Broadcasting Services Organizations'. However this reference relates solely to the provision of content services. Notwithstanding the KSO projects, basic telephony is still part of the exclusive rights granted to PT Telkom. The carriage of the content would therefore have to be supplied by PT Telkom, if part of the services included basic telephony. To the extent that basic telephony is not provided, arguably other networks, such as the cable and satellite network of Indovision could be used. However the regulatory position is far from clear. As elsewhere the government and the investors are still grappling with what is actually meant by multimedia and what product they are intending to provide.

Incumbent's Complaint against Constraints on Competition

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1. Abstract

Competition has been introduced in Korean telecommunications market since late 1980's. Interconnection arrangements among carriers and regulatory framework for them have been changed by the market situation. Asymmetrical regulation played important role for new entrants to settle down and to activate competition in the market. The incumbent, however, has suffered too much to compete fairly with the protected new entrants. Controversial issues are raised for the draft of new interconnect order from the perspectives of the incumbent and some suggestions are made to avoid conflicts. Barriers of any kind do not help fair competition at all. Regulation has better be liberalized for new entrants as well as for the incumbent.

2. Introduction

Telecommunication services had been provided under natural monopoly in many countries. The state had to expand services for various purposes and the number of entities that were able to raise the required resources were limited. In order to compensate for the mass investment, the market needed to be protected for a long time. Due to the technological development, the idea of natural monopoly was destroyed. New entry does not cost that much, and users request new forms of services that have never been asked. New carriers started to enter into the most profitable sector of telecommunication services market.

As the number of carriers is increasing in the telecommunications market, almost every new entrant talks about potential or real abuse of market power by the incumbent. To activate competition, it is believed that the regulators have kept protecting newcomers. It is, however, difficult to objectively evaluate whether the degree of protection is appropriate. Various asymmetric regulation measures and strict audit review of cost information become quite a burden to the extent that the incumbent feels unable to compete fairly with the protected new entrants.

So far, the arguments for competition were mostly made from the perspectives of new entrants and most of the incumbents have been defensive because they naturally lose market and relevant revenue. However, it is revealed that some measures taken for competition could hurt it and the benefits from competition are not fully harvested.

Most of institutional entry barriers have been removed or soon will be if not yet. In order to promote fair competition, many of restrictions put on dominant carriers also need to be removed and many regulatory measures should be liberalized. The suggestions will be made how the regulatory liberalization and removal of constraints promote fair competition both for newcomers and the incumbents, and how they help to keep consistency in rule-making and to motivate proper investments in infrastructure.

The remaining part of this paper is composed in the following manner. The purpose and effect of competition will be discussed. Later, major theoretical arguments on interconnection charge will be presented. We will, then, explain how interconnection arrangements have been changed in Korea. The problems and controversies on the initial, current and revising Interconnection Orders will be identified and evaluated, and finally some suggestions for improvement will be made.

3. Introduction of Competition and its Impact

In many developed countries, competition in telecommunication services market has started naturally. The demand in telecommunication services had been expanded to the level exceeding the economies of scale, and the monopolized carrier could not satisfy customers' need that developed along with advancement in technology. Whereas in many developing countries, competition has been introduced to attract foreign investments.

In Korea, the process has been rather unique.

Competition was introduced to effectively response to the foreign pressure for open market. The government decided to introduce competition within the country before opening the market worldwide. So far 37 licenses for basic telecommunication services and 318 for value added network services have been issued out. The table 1 summarizes the major development of competition in the telecommunication services industry for last 17 years.

Table 1. New Licenses Issued by the Ministry of Information and Communications

year	new licenses and orders	phone density
1981	Korea Telecom (all types of services)	8.4
1982	Dacom (data communications)	10.4
1984	SK Telecom (radio paging and mobile telephone, Korea Mobile Telecom at that time)	13.8
1985	Korea Port Telecom (port area services)	15.8
1991	Dacom (international)	33.7
1992	First Interconnection Order	35.7
	10 radio paging carriers (regional)	
1994	Shinsegi (mobile telephone)	37.8
1995	Dacom (domestic long-distance)	39.6
	Second Interconnection Order	
1996	1 international, 3 PCSs, 11 CT-2s, 7 TRSs, 2 leased lines	42.2
1997	1 domestic long-distance, 1 local, 4 TRSs, 1 radio paging, 3 leased lines	43.6

Prior to the Dacom's entry into the international telephone market in 1991, most of new entries were established for specialized services. Until then all types of telecom services were provided by Korea Telecom which used to be a government enterprise. According to the government's policy of "from the national competition to the worldwide competition", business licenses for telecommunication services have been issued to other entities. In the beginning, however, majority of the other entities was related companies of Korea Telecom since complete separation was not possible technologically and financially. Dacom was set up for data communication, and SK Telecom for radio paging and mobile telephone services as subsidiary companies of Korea Telecom. Both were later separated from Korea Telecom.

The international trend of free trade started to influence in telecommunications industry of Korea. The government planned to introduce meaningful competition by issuing business licenses to a number of companies. As results, we become to have unprecedented number of telecommunication operators.

The serious evaluation has not conducted for effect of the change. The attitude of Korea Telecom has surely been changed into customer-oriented. Prices have been lowered and the quality of services improved. Whether such improvement has been caused by competition is a bit questionable. The history of telecommunications industry has shown similar trend even before the competition. More distinctive improvement may be needed to prove the positive effect of competition.

4. Interconnection

4.1 Theoretical approach

Interconnection between different networks is crucial for new entrants because access to users is prerequisite for services revenue. How two or more networks are interconnected and how the compensation is calculated are two key features of interconnection.

Regulators and economists were eager to find out the best solution that satisfied incumbents as well as newcomers. They believed that cost-based interconnect charge should be implemented to induce economically efficient behavior. Equal access has been a crucial issue for competing operators, but the social costs of and benefits from it were never be fully analyzed.

Regarding the determination of interconnect charge, economists suggest numerous sharing mechanisms of usage charge among carriers that contribute to provide end-to-end service. Cost is now known as the best alternative for efficient resource allocation, even though very different concepts of cost have been discussed.

The level of an acceptable interconnect charge could be defined in a range. It should be low enough for the new entrants never to intend construction of their own networks. At the same time, it should be high enough for the incumbent never to hesitate investing in expansion and maintenance of its existing network. Technically speaking, it must lie between the stand-alone cost and the marginal cost of interconnection services.

Fully distributed historical costing method has been used in many countries even though it has been criticized for lack of motivation for efficient operation. Replacement costing or current costing is regarded conceptually superior to historical costing, but inferior in implementability. Incremental costing is supported by new entrants because it can lower the level of interconnect charge determined by fully distributed costing. Since common costs are never recovered under incremental costing system, strict incremental costing threatens viability of the incumbent.

In addition, experts such as Baumol and Willig emphasized the opportunity cost borne by the incumbents. According to them, the incumbents voluntarily provide interconnect services to competitors when they recover the lost revenue (opportunity cost) by providing interconnection services as well as the actual cost of network components offered. This mechanism allows market entry only to the carriers that are more efficient than the incumbents.

Though nothing is universally supported, each country desires best for itself by choosing the most appropriate method under their circumstances. While United States forces equal access and free competition, United Kingdom reserves equal access considering net negative effect of it. New Zealand decided to rely on commercial law rather than on special law for telecom industry. Australian government allowed Telstra charge Customer Access Network charge to competitors even though it decided to choose directly attributable incremental costing.

All these cost-based arguments are applicable to the relationship between local exchange carriers and long-distance carriers, in other words, among fixed networks. The relationship between PSTN operators and mobile operators is different. Mobile services are regarded as premium services with high prices. When the PSTN operator is involved in service provision, it is allowed to enjoy some surplus of high mobile tariffs. It does not hurt fairness because the mobile carrier usually takes bigger chunk of surplus than the PSTN operator. When the dominant mobile operator and the PSTN operator are totally separated entities, the conflict of interests between the two carriers is not negligible. The recent controversy on interconnection arrangement in Korea will be described next.

4.2 Korean Practices

As described previously, competition was introduced in 1991 for international telephone services. Prior to it, new carriers operated business in leased lines, TRS, data communications, radio paging and mobile phones under monopoly or duopoly at most. The interconnection arrangements did not matter. Since market entry was allowed by the government, new entrants believe adequate interconnect arrangement was also guaranteed with business licences. Moreover, some of new carriers were subsidiary companies of Korea Telecom. Both the government and the carriers were focused more on providing quality services than on possible problems with interconnection.

When any interconnection took place, the prices were determined in a simple way. There was no transaction between mobile carriers and PSTN operators. Both parties charge to their users for end-to-end services without any settlement for interconnection. For international telephone service, Dacom just paid for appropriate domestic rate to Korea Telecom for interconnection.

At the end of 1992, the government announced a set of basic rules for interconnection arrangements: First Interconnection Order. The charge was determined based on fully distributed costing (including fair rate of return on investment) and interconnect was classified into two different types; local only and local and long-distance combined. The rate international carriers have to pay for interconnection became lower than before.

While no-settlement was sustained between radio paging operator and Korea Telecom, the significant problem was raised between the

PSTN operator and a mobile carrier. The interconnect charge to a mobile network calculated by fully distributed costing was too high for Korea Telecom to pay. Since mobile phone business were not fully grown at that time, the unit cost was over 170% of PSTN operator's revenue from the call.

Other than the high interconnect charge to a mobile network, introduction of competition in domestic long-distance market also required some adjustments in the existing rule. In 1995, a new interconnection order was announced. New entrants, Dacom, was successful to persuade the government that strong protection was desperate for desirable market entry and stability. Discounts on local loop interconnect charge, exemption of NTS contribution and upper limit of interconnect charge up to their revenue for non-profitable sectors were introduced in the new order.

In addition, the users and providers of interconnecting services were uniquely defined. Whenever a local exchange carrier(LEC) and other carriers interconnect, LEC was defined as the provider and the other party the user. With this arrangement, the settlement problem between mobile carrier and PSTN operator disappeared. Instead, for calls originated from the PSTN and terminated to a mobile network, user charge belongs to a mobile carrier and, the LEC only collects cost-based interconnect charge. Underlined idea was that the PSTN operator should be fully compensated for its costs because the sound local loop management was foundation for the development of telecom industry as a whole. As results, all the surplus from calls between PSTN and mobile networks goes to the mobile carriers.

The new rule is now evaluated as a temporary remedy. No measures were provided for the arrival of various new services and accordingly various types of interconnect, and the local loop-centered idea is doubtful for its viability. In fact, the mobile networks have been expanded surprisingly fast in last couple of years. It is now difficult to regard mobile network as subsidiary one to PSTN.

In late 1996, a task force team was formed to review the current interconnect rule and prepare a new proposal. The government already issued licences to numerous business entities for various types of telecom services in June as shown in Table 1. It also recognized the weakness of the existing rule to handle complex interconnect relationship among carriers.

Many new ideas were discussed, but the perspectives represented during discussion were biased because the task force members were expert group of a few major carriers. Assuming that it could help lowering the level of interconnect charge, incremental costing issue was discussed even though most of the participants recognized that it was hard to be implemented. There were intense arguments on subscriber line cost. Majority of the team argued the costs would better be compensated by fixed rate charged to the subscribers. Economic efficiency and fairness would be improved when subscribers pay for the costs what they incurred.

Ideas represented in the initial draft are, in general, characterized as unrealistic and academic. For example, there was no serious consideration on universal service. It had been provided by the incumbent without any specific funding mechanism other than a minor portion of NTS contribution. Universal service must not be abolished under any circumstances, therefore, affordability is another critical factor for tariff setting. No subsidy for access deficit was provided on the initial draft of a proposal. No new funding mechanism was mentioned, either. If the rule becomes effective as was presented initially, it is expected that the fixed rate for basic telephone services would rise, and then, some poor group of people may have to give up telephone services. Universal service is never possible.

The new rule, revised from the initial draft, is now under final review by the Korean Telecommunications Committee. It does not seem to be reasonable and comprehensive enough to reflect interests of all related parties. Rather, it shows tint of political negotiation. The interconnecting carriers pay for a portion of subscriber line cost, but the long-term investment type cost (depreciation of subscriber line) should be borne by the local loop operator. Incremental costing was withdrawn due to the difficulty involved in implementation, but common costs are excluded. Many of the excessive protection measures for new entrants existing in the current order were eliminated.

In the next section of this paper, we are going to examine all the issues raised by interested parties and analyze consequences if possible.

5.. Controversial Issues

5.1 Exclusiveness of the Process of Rule Change

Initiatives for institutional change were usually taken by dissatisfied operators, and the process seemed to be exclusive. Most of task force members were delegates from major operators and they made up a draft for the new interconnect rule for about 3 months. No interim statements or opinion surveys were made. After the basic idea was discussed and decided within the task force, it was written for the draft without serious discussion by various interest groups. It is natural that users' benefit is not fully reflected under such situation. Instead, interest of existing operators could play important roles in the process because they were the key members of the task force team and no one except for the government is focused on the interest of users. Impacts of the new rule on operators' revenues and costs were fully analyzed while not enough attention was given to the interest of users. The survival of new entrants selected by the government was imperative. Task force team discussed fair competition endlessly but no discussion was held on social costs involved in enforcing the new rule. Public hearing needs to be activated for representing broad perspectives. Every issue raised at the public hearing must be fully discussed among interest groups and the decision should be validly justified. More experts have to participate in the process and more time should be invested. As wrapping up the work, everybody's name should be opened so that they become accountable for the new rule and the process becomes transparent.

5.2 Lack of Consistency

Interconnection arrangement, universal services, and tariff rebalancing are interrelated issues. Thus, we need to consider all three aspects for problem solving. In Korea, however, uniqueness of each were too emphasized to raise interrelatedness. Since individual trial for problem solving results in high uncertainty on other aspects for future business environments, carriers become too sensitive to be reasonable for reaching an agreement on any terms and conditions for interconnection.

When competition was introduced and so was interconnection charges, a portion of the charge was assumed to be a substitute for cross subsidy to keep providing universal services. If the portion is eliminated for economic efficiency without any other specific funding for universal services, users have to pay high prices and universal services are sacrificed. That is exactly what could happen if the new interconnection order becomes effective without modification. In a nutshell, the change of interconnection charge influences on the other two, universal services and tariff rebalancing.

The Korean approach to revise interconnect arrangements seems a little hasty and inconsistent. The government naively believes that straightening out the problematic interconnect regime that promotes cross-subsidy naturally leads to improving the other two. But it forgets that Korea does not have an institutional mechanism for funding universal services except for a small component in NTS contribution. The discussion restricted in a certain aspect could be in vain and the new rule can not last long, which increases social costs for frequent rule changes.

In order to promote competition and deregulation in telecommunications industry, substantial guidelines for local competition, universal services, and local access have to be prepared. All the legal, economic, and administrative barriers ought to be removed for local competition. New entrants can freely enter into the market whether they construct facilities by their own or rent them from other carriers. On the other hand, strong support mechanism for universal services has to be established to keep the local rate at an affordable level. For any revision or creation, interest of user groups should be represented through a formal process.

The cost for universal services needs to be clearly determined and the sufficient fund should be raised. Every carrier has to pay for it without discrimination. The carrier that receives support has to clearly announce how much goes to which services so that the paying party can set up tariff strategy and business plan in advance. Current implicit support mechanism ought to be analyzed in detail to determine the size of support, and the subsidy has to be externalized. When the carrier which provides universal services can be sure about full compensation, it never hesitate to reveal the size of implicit support.

For desirable results from the new sets of rules, it should be understood and analyzed what is happening in reality. Affordability has to be considered to set tariffs and the change should be gradual. Interim measures with a gradual plan would make sense. Korean government intends to liberalize regulation and promote competition through revised law and interconnection order. Profitability of local loop and affordability by users were not fully recognized, however. Lowering the level of interconnect charge is suggested for competitors but possible rise in fixed rate for local loop is not contemplated in detail. Everyone recognizes the need for universal services, but no one makes serious suggestion for funding mechanism. When the issue of inconsistency on related areas was raised, it was too late to be changed, and interested parties were eager to negotiate rather than straighten out the bend.

5.3 Lack of Incentives

Interconnection charges are set up by the rate of return regulation in Korea. Many pointed out the lack of motivation to minimize cost or improve efficiency as a major weakness of the rate of return regulation. External parties including the regulator do not trust reported cost information and managerial effort for efficiency by the incumbent. In order to avoid such a problem, it was designed not to compensate for a portion of costs. Such a mechanism, however, can only play as penalty as long as the ex post facto adjustment is made. No compensation without advance notice simply ends up with some loss for the paid party. However hard the incumbent pursues efficiency, it can never recover a pre-determined portion of costs incurred.

In addition, audit process is strict and accordingly it costs a lot. The costs for strict audit are never compared to the benefits from it. In other words, high cost is not justified. However strict the audit process is, it is almost impossible to detect internal problems such as management fraud. Rather, we can point out side effect of it. It is very likely for the confidential business information of the incumbent in competitive market to be disclosed in the process. That could be detrimental to the incumbent and hurt fair competition. Instead, active competition and adequate incentive system would be much beneficial both for the auditee and the auditor (regulator included).

5.4 Over-regulation

Serial changes of our regulation system for interconnection could be negatively evaluated in some sense. The government and other carriers distrust the cost minimizing efforts and the cost and traffic information reported by the incumbent. Introduction of competition did not substitute regulation with market mechanism, and the regulation does not seem to be liberalized sufficiently.

Implementation of optional calling plans has been delayed to sustain favorable environments for new entrants. Interconnection charges have never been negotiated by the related parties. When revenue sharing is discussed for the calls originated from the PSTN to a mobile network, the government is assumed to set up the sharing ratio. Such measures restrict the possibility of price decrease by align interests of both carriers for status-quo.

It is about time to move over to price cap regulation from rate of return regulation. Global price capping is strongly supported by Laffont and Tirole. It is believed to moderate side effects of other regulatory framework. Introduction of optional calling plans is recommended for users. And there must be a room for negotiation by two interconnecting parties as competition is taking place in the interconnect services market. It will make tariff setting process flexible, and carriers are free to develop or design new services with various price packages.

5.5 Excessive Protection for New Entrants

Driven · by the governmental policy of "asymmetric regulation", the new entrants have been very well protected. The most distinct asymmetry is shown in tariff setting and regulation on interconnection. While Dacom is able to freely introduce various discount programs, the price decrease by Korea Telecom requires the government approval. The government thinks that price difference between the Korea Telecom and Dacom is more important for survival of Dacom than any other competing factor. As results, the price decrease after introducing competition in domestic long-distance market never exceed that happened before. To be more specific, the price is decreased by 15-20% every year since 1990. Though it is a bit early to evaluate the effect of competition (because it passed only two years since competition has started), the price was decreased only once by 10%. The similar trend is shown in international telecommunications market. The 35% price decrease took place for 5 years before the second carrier started business while only 22% decrease has taken place for 5 years after competition. Various discount programs were introduced before than after the competition. Due to the government's intention of keeping price differential, the dominant carrier can not initiate price decrease, which ends up with slower price change than desired. Well protected new entrants might want to stay under the "price umbrella"of the incumbent.

5.6 Indifference to Social Costs

Preregisteration of a long-distance carrier could be a critical factor for fair competition and has been completed in several competition -oriented countries. The Korean Government announced it would do it in late 1997. Nevertheless, in depth evaluation on social welfare and costs seems to be ignored in the decision making process. Equal access is a great idea by itself for new carriers and their users. Costs for implementing it is quite high, though. Net effect of equal access on social welfare is not necessarily positive. In fact, OFTEL announced it did not force equal access since the net social welfare effect was estimated negative whatever options were taken. The decision for equal access seemed to be made in a hurry due to the conflict of interests among competing operators.

5.7 Lack of Attention on Modernization of PSTN

Almost all the decisions are made favoring new entrants under the name of fair competition and severe distrust in the dominant carrier is underlined. Under the situation, the interest of the incumbent who operates local loop is not properly considered. The local loop is basic common utility any telecom carrier has to use for their business. It would be too late for expansion or modernization when actual demand are recognized. Adequate investment should be made in advance and its operation be properly compensated. For fair competition, the Korean government weighs survival of new entrants heavier than reliable local loop operation. Neglecting profitability of local loop operator can end up with failure of many interconnecting carriers. The cumulated earning power of the incumbent is exhausted by excessive protection for new entrants. New reserve for the expansion and modernization of local loop is desperately needed for upcoming information society.

In order to draw out an appropriate level of interconnect charge, the costs incurred, including opportunity costs, have to be properly compensated. The biggest problem in interconnect charge determination declared in the new interconnection order is, we believe, no coverage of common costs. It brings down the interconnect charge rate but offers little incentives for investment in local loop by new entrants and modernization of it by the incumbent. It may promote competition for the time being. Its long-term effect could be, however, detrimental for developing infrastructure for telecommunication services. Economic efficiency is crucial for determining the interconnect charge. But incentive is another factor which should never be forgotten. Australian example of Customer Access Network charge is very insightful. The two important factors should be harmoniously combined based on full understanding of the environment.

6. Conclusion

Competition is only a tool to obtain a goal of maximizing social welfare. This paper tries to examine how the Korean policy for telecommunications industry affects the developmental process of interconnection arrangements among different networks. Obligation of interconnection and a reasonable and logical way of determining interconnect charge are necessary to avoid duplicated investment and to efficiently use the existing network.

Interconnect charge is a major cost component for new entrants. If the level of interconnect charge is too low to cover the cost, even the inefficient carriers could stay in the market, and cause rise in total costs. On the other hand, new entrants would prefer constructing their own networks to interconnection if the level of interconnect charge is too high.

In order to harvest fruitful results from competition, the opinions from various interested parties should be reflected in the interconnection order. The process of rule change and/or rule making must be open and transparent so that it is not interfered by any irrelevant political motive. The interrelated issues to interconnection ought to be discussed jointly. Local competition and universal services are closely related to interconnection.

In addition, interconnection arrangements must be able to provide incentives to operators for efficient management. Restrictions by the government have better be removed so that carriers do not rely on their lobbying power. Excessive protection for new entrants has to be moderated for the interest of users. The interest of users can never be sacrificed while dominant market power of the incumbent could be cut down if necessary. Along with the emphasis on interest of users, we should not forget that the existing local loop is social and industrial infrastructure which has to be expanded and modernized for all types of services. Last but not least, the social costs and benefits of any rule change have to be carefully evaluated and validly justified both from short-term and long-term perspectives.

References

Lewin, David, and Malcolm Kitchen, 1994, Interconnect: the key to effective competition, Ovum, London, England

Lewin, David, and Richard Kee, 1997, Interconnect: a global guide to effective telecommunications, Ovum, London, England

Ministry of Communications, 1992, Interconnect Order, Seoul, Korea

Ministry of Information and Communications, 1995, Interconnect Order Revised, Seoul, Korea

Ministry of Information and Communications, 1997, Draft of Interconnect Order 2nd Revision, Seoul, Korea

OFTEL, 1997, Network Charges from 1997, London, England

Tirole, Jean, 1997, "Remarks on Regulatory Issues", Competition and Regulation, Dongkuk University, Seoul, Korea

Telecom Market Liberalization in Taiwan

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1. ABSTRACT

The Cabinet in Taiwan launched the Asia-Pacific Regional Operations Center Plan[1] in 1995 as a formal attempt to shift Taiwan's economy towards more private ordering. The APROC Plan bears the mark as a "cross century initiative"[2] with respect to seven areas of project implementation.[3] Among them, the three-phased Regional Telecom Center Program[4] was first on the ROC government's agenda for execution.[5]

The purpose of this paper is to pinpoint and analyze the Program's recent development and implementation. The first part seeks to provide a synopsis of the pertinent historical background, inherent problems and potential economic impact. Second, this paper will examine the new regulatory regime and the Telecom deregulation contemplated by the Program. In particular, the legal reforms necessary to implement the Program and the relevant issues stemming therefrom will be explored. Moreover, the deregulation of the satellite television industry, which is currently under implementation, will also be outlined.

2. HISTORY OF TELECOM REFORM EFFORTS

2.1 TELECOM MARKET AND REGULATION BEFORE THE 1990s

Until its amendment in February 1996, Taiwan's Telecom Law[6] of 1958 maintained a bureaucratized and monopolized model for its Telecom market.[7] However, the monopoly arrangement in Taiwan became undesirable in light of global trends,[8] and the Directorate General of Telecom[9] together with other government agencies[10] began studies of liberalization in the early 1980's. As a result, domestic companies were allowed in the late 1980's to provide limited value-added services. However, liberalization did not begin quickly enough.[11] It was not until 1995 that the anti-competitive policy was re-examined by the Council of Economic Planning and Development[12] and eventually discontinued in 1996.

2.2 TELECOM REFORM BILLS, APROC PLAN AND RENEWED IMPETUS

After various legislative attempts to amend the TL since the 90's,[13] the Executive Yuan[14] adopted an ambitious APROC Plan in early 1995 to engineer more economic liberalization and internationalization to enhance Taiwan's competitiveness.[15] The Plan, *inter alia*, contains a three-stage blueprint to facilitate the telecom market opening in Taiwan. First, the second generation cordless telephone business[16] was to be opened to the private sector. Second, four additional segments of the wireless telecom market would be opened for competition: cellular phone, paging, trunking radio, and mobile data. Third, competition in the wired/fixed line basic service market, including the previously deregulated satellite television industry, would be introduced within five years.

In a way, the telecom program within the APROC Plan added more impetus for telecom market reform in Taiwan as it represents the renewed commitment of the EY. However, it also highlighted the urgency for the passage of the three telecom reform bills[17], because the second stage of the market opening could not be implemented successfully without having these bills passed first.[18] As such, in July 1995, the APROC Window/CEPD formally intervened to re-examine the three telecom reform bills pending in the Legislative Yuan.[19] The aftermath sees the much revised and improved bills with each adopted on January 16, 1996, but only after intensive debates and enduring consultation were made.[20]

3. NEW REGIME CONTEMPLATED BY THE THREE REFORM LAWS

3.1 BIFURCATION OF REGULATORY AND BUSINESS UNITS

As amended, the TL now requires the DGT to be a mere independent regulator. The DGT's business unit was to be privatized as Chunghwa Telecom Corporation,[21] which took place on July 1, 1996. Yet, due to a major compromise among political parties to placate the activist DGT union members, the amended TL provides that CHT will be a state-owned company. In other words, unless the LY gathers political support to amend the TL in the future, CHT will remain majority-owned by the government.

3.2 CLASSIFICATION OF TELECOM SERVICES

The TL also classifies Telecom industry into type I and type II[22]. Importantly, it follows a "negative listing" approach for this classification and provides that a type II business is whatever activity not canvassed by type I. The type II market is generally open to competition, and licensing would be based on a pro forma review. Foreign ownership in the type II industry is not limited. On the other hand, the type I industry is subject to an oligopolisic model; competition will be gradually introduced and segmentation within the basic service market will continue for some time.

In connection with this new TL regime, the government in Taiwan also determined to allow some competition in the mobile telecom sector. However, a formal policy decision was made by the EY in October 1995 to give CHT a five-year grace period to engage in the fixed-line telecom business beginning from its incorporation on July 1, 1996. In other words, licensing and review should occur before the end of this century to ensure that by July 1, 2001, new providers for fixed-line basic services will enter the market.[23] In fact, the EY has recently decreed the market opening schedule for fixed line Telecom business.[24]

3.3 FOREIGN OWNERSHIP LIMITATION

To maintain the competition model for the type II industry, there is no foreign ownership restriction for equity investment. However, foreign ownership in a type I business is limited to 20% under Article 12 of the TL as newly amended. This is substantially lower than the one-third limit contemplated by the CEPD under the revised TL bill of 1995 but far better than the 1992 bill, which would have ruled out foreign ownership entirely. Essentially, the 1992 bill represented the old DGT's tactic of using foreclosure of foreign participation as leverage for Taiwan's bid to join the World Trade Organization[25].

Importantly, under the revised 1995 TL bill as enacted, CHT would also enjoy this 20% foreign ownership quota. Moreover, the TL provides that a majority of the directors and supervisors of a type I telecom company have to be Taiwan nationals. This means that foreigners could fill up to slightly less than a majority of the board or supervisors, if agreed to by the local partners. This disproportionately larger quota for directors or supervisors was a deliberate attempt to permit international strategic alliances to be made in the future.[26]

For comparative purposes, the Satellite Broadcast and Television Law bill[27] in Taiwan does not restrict foreign ownership.[28] The direct satellite television business is a new industry in Taiwan, however, certain laws already embody the regulatory policies in this area.[29] Initially, the Government Information Office[30], the administrative agency vested with the power to oversee broadcasting and television activities, proposed a foreign ownership restriction of not exceeding 50%, a requirement which would essentially deter any serious foreign investors. The GIO then altered this position at the urging of the Council of Economic and Planning Development so that foreign ownership now may not exceed 51%. By doing so, the GIO adopted a different logic: that is, foreign investors could gain control as long as they take on minority local partners. The Council of Economic and Planning Development had argued that companies such as Asian Business News chose Singapore instead of Hong Kong because of a more relaxed ownership requirement.[31] Additionally, the EY ministers thought that foreign ownership restrictions would not make sense in the area of satellite broadcast and television, since airwaves do not recognize borders. Therefore, the final EY bill removed all restrictions on foreign ownership.

3.4 OTHER SALIENT FEATURES OF THE AMENDED TL

By like token, the ramification of the TL is widespread and raises other contentious issues especially in the following areas:

1. The equal access rule and the specific obligations of type I telecom companies to provide interconnection to other telecom companies;[32]
2. The universal service fund obligation;[33]
3. Rules against discrimination;[34]
4. Tariff liberalization;[35]and
5. Fees for frequencies;[36] .

4. CORPORATIZATION OF CHT

One important feature of the Program is to corporatize the CHT. It would have made some economic and political sense to break up the business arm of the DGT into several operating companies, much like the involuntary divestiture of AT&T in 1984, so as to generate more competition in the Taiwanese telecom market. However, this alternative was quickly ruled out because of the high political cost and low political will of such an action. Although privatization has not been completely ruled out, it is not a short-term solution either. Corporatization of the DGT's business unit, therefore, was the only remaining politically feasible solution. In addition, the old DGT and its activist union members thought it was not sufficient to just rely on general corporate laws for such corporatization. The political commitment of granting job security to DGT employees necessitated that a political promise be permanently enshrined in some legislation. Hence, the CHT Law.

However, the process of corporation was not smooth, and the CHT Law was only put into effect after the following competing interests were reconciled and issues resolved:[37]

1. Job security of CHT employees and their labor participation in management;[38]
2. Board and management qualifications, civil servant status;[39]
3. Ownership diversification in lieu of privatization, strategic sale;[40]
4. More autonomy and restructuring at CHT;[41]
5. Fair competition in the new market;[42] and
6. Relicensing.[43]

5. RECONSTITUTING THE DGT

The DGT Law seeks to reconstitute the new DGT as a mere professional regulator within the Ministry of Transportation and Communications. However, during the legislative debates for adopting the three telecom reform laws, there had been some proposals for having a more independent and powerful regulator such as the United States' FCC. As a result, some compromise had to be made. In other words, some independent and even adversarial mechanisms had to be built into the architectural design for the new DGT.

5.1 DISPUTE RESOLUTION COMMITTEE

Specifically, the DGT Law mandates that a Dispute Resolution Committee be set up within the DGT. The committee is to be composed of representatives from political parties, agencies, academics, experts and consumer groups. Proportionate representation is required; representatives from the same category may not exceed one-third of the total, and representatives belonging to the same political party may not exceed half of the total. More importantly, even though the DGT is only a subordinate agency of the MOTC, which is supervised by the EY, members of this committee should be directly appointed by the EY.

The Dispute Resolution Committee, therefore, is a potentially powerful check on the DGT. However, preparations for impaneling it and staff work supporting it must come from the DGT itself. In Taiwan, it is also possible to seek administrative relief by appealing to the supervisory authority[44] of the agency[45], rendering an adverse adjudication before judicial review is sought. So should decisions by the DGT be first referred to this committee or directly appealed to the MOTC and EY? How should decisions of this committee[46] be handled by the EY if it receives an administrative re-appeal? In real politics, how should such dispute proceedings interact with possible parallel dispute proceedings before the Fair Trade Commission alleging Fair Trade Law violations? These are all new issues brought about by the DGT Law amendment.

5.2 POLITICAL IMPACT AND CHALLENGE

The requirement of political party representatives in this committee introduces the possibility of politicking for their nomination and the work of the committee. While this may be a necessary evil to ensure that the DGT will not favor CHT, the cost of maintaining such political elements in dispute resolutions will not be insignificant. How to enhance the size, professionalism and morale of the DGT staff is also an imperative issue. Unless the DGT develops a highly motivated and adequate staff imbued with professional esteem and expertise, efforts to liberalize the telecom market in Taiwan will be insignificant.

6. MARKET OPENING

6.1 MOBILE TELECOM

As referred to above, there are three main phases of the Telecom market opening[47] for the coming decade. In this connection, MOTC/DGT have proceeded to entertain applications for mobile telecom operations in the four segments. Thus far, 17 international consortiums have filed 42 applications for 8 mobile phone operator licenses. In addition, 32 applications have been made for 8 paging operator licenses, 31 applications for 17 mobile data operator licenses, and 98 applications for 20 trunking radio operator licenses. In total, 102 groups have filed 203 applications for 53 licenses in connection with the mobile telecom market opening program. Recent statistics[48] and the recent award of trunking radio licenses[49] show that further deregulation is likely to continue.

6.2 INTERNATIONAL INTEREST

There has been much international interest in the telecom market contest. The heavyweight participants reportedly include AT&T Wireless, AirTouch, Southwestern Bell Corporation, Mitsubishi, Nynex, France Telecom, Telia, First Pacific, Sprint, GTE, Telstra, Sumitomo and Ameritech. Rigorous competition is also foreseen in the satellite television market. According to the local press[50], international companies such as MCI, AT&T and Sprint have revealed deep interests to set foot in the local satellite industry, and numerous negotiations for joint venture projects are underway. A notable example is the cooperative arrangement consolidated between AT&T and two local companies, TTN and the Far East Group. Even though the local market is still inchoate and unpredictable, rapid progress is expected on these fronts. However, the unique political, social and economic background of the telecom market opening in Taiwan promises to be challenging for these international firms and their Taiwan partners, as well as regulators.

6.3 FOREIGN OWNERSHIP LIMITATION REVISITED

Several challenges have surfaced, while others have loomed ever larger on the near horizon. First, a method to compute the 20% foreign ownership limitation in mobile telecom operators already requires some clarification. Frankly, the TL is unclear on this issue. The controversy came about because even local companies taking the lead to form such international consortiums may already have foreign shareholders as a result of Taiwan's trade and investment liberalization program of the past decades. For example, some of such foreign investors in leading Taiwan companies are strategic investors, while others are portfolio investors who invest in listed Taiwanese companies under the government Qualified Foreign Institutional Investment[51] program. Currently, aggregate QFII ownership in any publicly listed or quoted company may reach 20%, the same level as under the TL. This portfolio foreign investment quota, however, will increase over time as Taiwan further internationalizes its capital market.

Therefore, would such indirect foreign ownership reduce the quota for direct foreign ownership in the new telecom companies to operate any of the four new mobile businesses?

A literal interpretation suggests that it would, which means that all indirect foreign ownership should be summed up under a "vertical dilution computation" principle so as to scrutinize whether the 20% quota has been filled. This could be an administrative nightmare for both the consortiums and regulators because of the high cost of constantly monitoring share transfers. Where the Taiwanese companies involved in the chain of corporate ownership are publicly listed companies whose shares change hands every trading day, monitoring is particularly difficult.

A more thoughtful interpretation would suggest that the computation of foreign ownership should follow the "control" test. In other words, if any constituent companies are controlled by foreign owners or corporations, their shareholding should be attributed towards the 20% quota. Control could follow the more rigorous majority ownership test or the more flexible "effective control" test, which is not unheard of. When the Taiwan Securities and Exchange Commission[52] liberalized the securities brokerage market, subject to some foreign ownership limitation, it was exactly what the SEC had done in 1989. The SEC liberally interpreted the 10% per foreign shareholder requirement under the 40% aggregate ownership limit; four foreign holding companies held by the same group could invest in a local securities firm without violating the 10% quota for single foreign shareholders.

Either the majority control test or the effective control test for this alternative interpretation would ensure more robust competition, because the incentive for foreign telecom companies to participate in the mobile telecom market would be significant. Following either test, however, this interpretation could lead to indirect, beneficial ownership exceeding the nominal 20% quota. It would also suggest that foreign shareholders as a group, rather than local shareholders as a group, could become the dominant voice in such international telecom joint venture companies.

In the midst of highly contentious democratization and following a cabinet change in mid-1996, the MOTC/DGT position took a predictable turn for conservatism. The strict, literal interpretation requiring vertical computation of all indirect foreign ownership was taken up. Under this conservative approach, there would not be any challenges by legislators or local companies who would be able to maintain dominant ownership. All applicants were asked to submit their application documents and business plans on the basis of this interpretation. On the other hand, the problem with monitoring change in foreign ownership in the future has been temporarily swept under the rug.

6.4 PRICE CAPPING OR RATE OF REGULATION

Another issue which has cropped up is the rate-of-return rules for tariff regulation. The TL of 1958 had contemplated a rate-of-return pricing model for a public utilities monopoly and required a pricing formula for such tariff to be approved by the LY. The 1996 amendment to the TL has not changed this aspect, even though competition will gradually be introduced in the telecom market. This rate-of-return regime claimed that mobile telecom applicants would create an anomaly, at least in so far as the mobile telecom market is concerned. Instead, it was argued that a price capping approach should be adopted for a market gravitating towards a competition model.

In the bilateral trade consultations with the United States' negotiators in mid-1996, the DGT reportedly was open to making some changes in this regime, subject to further studies to confirm the merits of price capping arrangements and the legislative approval to amend the pricing formula for the tariff. Assuming such willingness, how a price capping formula would work in a dual regulatory regime is worth some serious consideration. Presumably, only one price cap tariff can be adopted for both sectors since it must be a "one size fits all" regulation. In a dual regime, although the private-sector mobile telecom operators will have a strong profit motivation, CHT as a state-owned enterprise may not be so motivated to improve upon its efficiency. The CHT Law has guaranteed the remuneration of most of its employees as civil servants. Therefore, even within CHT itself, this dualism adds complications to any price capping proposal.

6.5 RATE RE-BALANCING

Another issue relating to the tariff pricing regulation is the rate re-balancing program. In the past, the DGT has resorted to higher profits from long distance and international calls to subsidize local calls. In connection with introducing competition in the telecom market, rate re-balancing would be necessary to prevent market distortion which otherwise would follow, as new entrants in a cross-subsidized market would choose to "skim the cream" if such an opportunistic option was available. While the 1995 rate re-balancing program by the DGT in anticipation of the passage of the telecom reform legislation proceeded uneventfully, the 1996 rate re-balancing program by CHT, in the midst of mobile telecom market opening, drew much criticism and concern that this could be a predatory ploy.

6.6 SATELLITE TELEVISION

The opening of the four segments of the wireless market has triggered the third phase of Telecom Deregulation. The viability of the government's undertaking to liberalize may once again be tested in this unfamiliar environment. In this regard, MOTC has devised a plan to launch direct satellite television business in Taiwan and 25 licenses will be released for the operation of satellite television operations by the end of 1999. This plan is classified as urgent and is high on the MOTC's agenda. According to its current schedule, MOTC promises to have the relevant proposals for liberalization ready by the end of 1996 and the precise ambit of permissible satellite televisions operations would be delineated by May of 1998. Interested parties may tender open bids for a license(s) in August of 1998. Permits will be awarded by the end of 1998 and the operational license will be issued by the end of 1999, to render a one full year service preparation period for the awarded operators.[53]

Direct Satellite Television Business in Taiwan is virtually non-existent. Therefore, issues of its regulation arise from the cable television business in Taiwan, one of the most dynamic markets in the APEC region. Because of the density of communities in Taiwan[54] consumer behavior, the perceived inadequacy of the oligopolistic government and KMT-linked terrestrial television stations, cable television has become the alternative television industry. Currently, Satellite signals are down-linked only to be transmitted through the CATV systems.[55]

Even though direct satellite television is a way of the future, several of the legislation - not entirely consistent among themselves - already embody Taiwan's regulatory policies in this area.[56] The Satellite Broadcast and Television Law bill was drafted by the GIO facing these circumstances. It was approved by the Executive Yuan in September of 1995 and sent to the LY for deliberation.[57]

6.6.1 SALIENT FEATURES OF THE SBTL BILL

SBTL was introduced by the EY to redress the inadequacy of various legislation[58] in dealing with television and broadcasting issues. The bill is policy oriented and seeks to maintain the public interest with the following stipulation.

First, offshore program providers may not supply programs or advertisements in Taiwan unless they set up a branch or appoint an agent in Taiwan and have reported such arrangements to the GIO for its recordation. As a result, system providers, cable television system operators, and radio and television stations may not air such programs or advertisements of non complying offshore program providers.[59] Offshore program providers airing programs or advertisements violating the SBTL provisions[60] could lead to vicarious administrative penalties[61] levied on their Taiwan branch or agent.[62]

Second, substantive regulation under the SBTL does not appear to be cumbersome. It sets forth application procedures, qualifications, requirements for business plans, license duration[63] and review standards for such applications.[64] A name change or change in the responsible persons[65] would require the GIO's approval, whereas share transfers, suspension of business and termination of operations have to be reported to the GIO within 15 days.[66]

Third, regulation of programs and advertisements under this bill is essentially a repetition of similar provisions in the Cable Television Law. An exorbitant provision encourages the export of locally made programs to facilitate cultural exchange and requires compliance with international treaties and practices concerning satellite broadcast and television.[67]

Fourth, what the SBTL bill does not require is also worth noting. For example, as referred to before, it does not restrict foreign ownership.

Fifth, the SBTL bill does not contain any local program/contents requirements either. This has been a traditionally sensitive area; academics in Taiwan are often divided on this issue. On the other hand, Taiwan-made programs such as the highly successful Judge Bao soap opera television series demonstrate - for lack of a better characterization - the competitiveness of the Chinese culture. Indeed, there have been reports and assertions that, if cultural aggression is a real threat, elsewhere in Asia the Chinese culture[68] is deemed to be threatening to other cultures.[69]

Sixth, the SBTL bill is fairly open about entry by those media firms which are already well entrenched. Therefore, it does not prevent the three terrestrial television stations in Taiwan from entering this market segment. Again, this is a very controversial issue, particularly to the opposition parties. On the other hand, these three stations do have some competitive strengths if one views the market as larger than Taiwan itself.[70]

6.6.2 CURRENT STATUS OF THE SBTL BILL

The SBTL bill seems to be at a stalemate at this point. Meanwhile, some DPP Legislators have tabled a competing bill. For example, this competing bill would limit foreign ownership in a direct satellite broadcast television system operator to 20%. Foreign ownership in a satellite broadcast television channel operator would be limited to 50%. Also, under this bill the three KMT or government-affiliated terrestrial television stations will be locked out of this market as it would prohibit investment by such stations that have more than 30% of their shares held by the government or a political party. In addition, this bill would prohibit direct broadcast satellite. Offshore channel operators would be required to apply for a down link permit and would have to contribute to a fund.[71]

The requirement that offshore program providers must set up a branch or appoint an agent is also controversial. Free traders argue that this is an anti-trade measure; certainly where international trade in goods is concerned, there has been no such requirement. Proponents, essentially the GIO itself, believe that without this provision they would not be able to control the legality of programs and advertisements. Indeed, in October 1995 the GIO had sanctioned 92 CATV system operators for airing non complying programs supplied by offshore program providers. However, this decision was quashed by its own Administrative Appeals Committee, which held that the local operators had no way of controlling the programs or advertisements and thus could not be fined.[72]

Arguably, the GIO could resort to another statute without having this provision in the SBTL bill. In other words, the Broadcast and Television Law already provides some authority for sanctions. Article 2 of that law arguably defines television broadly enough to include satellite television.[73]

Another interesting twist on this requirement is found, surprisingly, in the interpretation of Taiwan's income tax law and regulations. Without a branch or agent, offshore program providers would incur a flat 20% withholding tax on the income generated from licensing the programs. Because of disproportionate bargaining positions, they would ask local operators to absorb such tax, thereby increasing the royalty. Even so, the proposed requirement of setting up a branch or appointing an agent will test the strength of Taiwan's long arm laws.[74]

Some Legislators are involved in the CATV business themselves or closely associated with CATV operators. To some of them, the branch/agent requirement for offshore operators could solve this industry problem. Satellite channel operators in Taiwan and abroad are generally lukewarm about the SBTL bill; they view it as regulatory. Those who are interested in the direct broadcast television systems, however, view this bill as enabling; without it, they are afraid the GIO cannot find other legal authority to allow such business to exist.[75]

The LY's current session promises to be as politically charged as the one before. Unlike other economic regulatory legislation, the SBTL bill involves significant cultural and political issues. As a result, its passage (and if so, the compromises made) is subject to various competing forces.

7. PROSPECT AND IMPACT

Through the lens of the 1995-96 telecom reform program in Taiwan under its APROC Plan, one is offered a glimpse of the complicated political, economic, legal and social issues affecting Taiwan's efforts to embrace the information age. In retrospect, it was even amazing that a package of reform legislation as politically sensitive as the TL, DGT Law, CHT Law and SBTL could receive passage by the contentious LY. But, the pressure for more ambitious reform is mounting as several international developments take shape. First, the European Union is poised to begin the onslaught of free and full competition in basic service among its members in 1998. Second, the WTO is slated to complete the negotiations on basic telecom services in 1997.

Telecom reform is a topic both subject to significant domestic pressure and gives rise to serious inquiries of the quality of Taiwan's political system. Will Taiwan's complicated constitutional system stifle the competitiveness of its state-owned enterprises such as CHT? Will CHT fall prey to pressures and undue influence of local governments now that it has to pay value-added tax, a form of local taxes? Will it succumb to employee pressure to have labor representation in the board of directors? If this should happen, what would be the spoiled over effect on the private sector? Will CHT pre-empt or stonewall competition by private operators, either consciously as a monopoly facing decreasing market share, or vicariously through government policies artificially resisting market mechanisms to allow a longer grace period for the state-owned telecom company to catch up?

Policy issues aside, at the practitioners' level, the telecom reform will lead to a new area of practice for telecom industry managers, consultants, lawyers, bankers and investors. The three telecom reform laws now have forced the government to rethink policy issues relating to the Cable Television Law, Broadcasting and Television Law, Satellite Broadcast and Television Law bill and even the outdated Publication Law. Also, how will these reform laws interact with the FTL and Consumer Protection Law, which stress competition policy, and the Statute Governing Privately Owned Public Utilities, which stresses economic regulation? How would the operational provisions of these reform laws interface with other laws relating to land use such as the Land Law and Building and Apartments Law? Even among government officials, how would these reform laws interact with the more traditional laws and rules governing civil servants, government procurement, administrative relief and judicial review of agency actions?

I surmise that much trial and error will occur in the five-year period leading up to July 1, 2001 when competition for fixed line basic Telecom service will ultimately be introduced. Undesirable as such a hazardous approach is, unfortunately there may not be a way around it. As a byproduct of the precocious democracy in Taiwan and its unique international status, political factors will spice up further telecom market reform initiatives in this dynamic economy.

End notes

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[1] Hereinafter referred to as "APROC Plan".

[2] The Plan manifests an intention to assist Taiwan to, inter alia, (1) better meet the global political and economic challenges of tomorrow; (2) rapidly integrate with regional nations, in particular, to enable Taiwan to cooperate with regional states, such as Hong Kong and Singapore, rather than to compete with them; (3) entrench Taiwan's international status; and (4) arguably, to strengthen the ties across the Taiwan straits.

[3] Remark made by Premier Lien Chan, the seven areas include the (1) macroeconomics adjustment program, under the Council of Economic Planning and Development; (2) regional manufacturing center program,

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under the Ministry of Economic Affairs; (3) regional sea transportation center program, under the Ministry of Transportation and Communications ("MOTC"); (4) regional air transportation center program, under the MOTC; (5) regional financial center program, primarily under the Central Bank of China ("CBC") and secondarily under the Ministry of Finance; (6) regional Telecom center program, under the MOTC; and (7) regional media center program, under the Government Information Office.
For more discussion in this respect, please refer to Lawrence S. Liu, *Aspiring to Excel - The Uneasy Case of Implementing Taiwan's Asia-Pacific Regional Operations Center Plan*, 10 Columbia Journal of Asian Law 199 (1996).

[4] Hereinafter referred to as "Program".

[5] The Telecom implementation program is 3-tiered. Please refer to part 2 below for more detail.

[6] Hereinafter referred to as "the TL".

[7] Under this regime, the MOTC was responsible, through its Directorate General of Telecom, to implement Telecom policy and operate the only Telecom business in Taiwan.

[8] 1980's saw the gradual privatization of state-owned Telecom companies and liberalization of the Telecom market in North America and Europe in light of technological advances.

[9] Hereinafter referred to as "DGT".

[10] At the same time, the Council of Economic Planning and Development, a council for ministers within the Executive Yuan, also began to research telecom market reform measures abroad.

[11] In the area of the procurement of switching equipment, a decision in the mid-1980's under foreign trade pressure actually led to a three-way oligopoly. Each equipment supplier (one each for northern, central and southern Taiwan) was set up as an international joint venture affiliated with the DGT.

[12] Hereinafter referred to as "CEPD".

[13] In April 1992, a bill to amend the TL as drafted by the DGT was submitted by the EY to the Legislative Yuan (hereinafter referred to as the "LY"). However, this bill, even though a good cornerstone for future development, was perceived by many LY members to be lacking both in scope and substance for sufficient competition. Consequently, the LY demanded the submission of two additional bills to amend the Organic Statute of the DGT (hereinafter referred to as the "DGT Law") and to enact an Organic Statute for Chunghwa Telecom Corporation (hereinafter referred to as the "CHT Law") so as to privatize the business unit of the DGT. Even though these two bills were submitted by the EY in December 1994 for the LY's deliberation, the controversies surrounding market opening and boycotting by the DGT employees had led to a stalemate. Moreover, about nine competing bills were initiated by various LY members on their own. The efforts to open the Telecom market were stranded.

[14] Hereinafter referred to as the "EY".

[15] The APROC Plan was drafted by the CEPD, and a Coordination and Service Office for the Asia-Pacific Regional Operations Center (hereinafter referred to as the "APROC Window") was set up to implement this initiative and coordinate the inter-ministry efforts towards its fruition.

[16] Hereinafter referred to as "CT2". Please also refer to Table I.

[17] Refers to the TL, DGT Law, and the CHT Law bills.

[18] One important element of this second-stage market opening was foreign participation, which would have been blocked by the TL of 1958.

[19] *Supra* n. 3, "LY".

[20] After intervention, intensive consultation ensued with the relevant ministries to substantially improve the three bills. Fundamental principles governing the revised telecom reform bills were adopted by the EY in early October 1995, along with the APROC Window/CEPD's recommendation that the revised bills be initiated by ruling party LY members. However, the ruling LY party lost the early December 1995 election in the sense that its majority status in the new LY, to begin in February 1996, would consist of a razor-thin margin of only a one-vote advantage. The possibility for enacting the revised telecom reform bills was slim, and the consequences of this prospect were dire. However, after more than one hundred briefings by the core CEPD/MOTC team to the LY, various political parties, the industry, academic and consumer groups, and the media, and despite contentious opposition by DGT union activists, the three telecom reform bills as revised were adopted on January 1 6, 1996, just before the 1995 LY session ended.

[21] Hereinafter referred to as the "CHT".

[22] Type I refers to the basic Telecom services, and type II refers to value added or enhanced services.

[23] For more details, please refer to Table I.

[24] Please refer to Table I.

[25] Hereinafter referred to as "WTO".

[26] Recently, CEPD/MOTC were involved in a discussion[26] in May of 1997 seeking to present a bill to the EY for raising the investment restriction from 20% to not exceeding 50%. This would be a substantial increase from the original benchmark, and would allow more leverage for foreign involvement in the local market. However, this not exceeding 50% ratio was not easily agreed upon by both CEPD and MOTC as the contentious issue regarding whether protection should be afforded for Type I business resurfaced. CEPD seemed to be a strong proponent for the Telecom market liberalization as it preferred the relaxation of the current foreign investment restriction. According to CEPD's method of calculating foreign equity for investment, the highest foreign holding permitted could amount to 60%, including both direct and indirect investments.

The MOTC, however, held a different stance. Despite its willingness to cooperate for deregulating the local telecom market, the MOTC preferred that the foreign share-holdings in aggregate of a telecom entity must remain as minority. The MOTC insisted on local shareholders to remain in control of the management of a Taiwanese telecom company. Based on this rationale, MOTC's view prevailed, and the proposed equity restriction ratio was tentatively set at 50%.

Under the proposed legislative framework stemming from the Discussion, a foreigner is permitted to have a less than 50% shareholding in a type I Telecom business. However, the less than 50% equity investment limit does not solely represent direct investments. Foreigners are only allowed to make 30% in direct investments and 20% in indirect investments through a third company or a subsidiary. The rationale for this imposition is unclear, and, in practice, distinguishing between direct and indirect investments in this manner may hinder a foreign entity's willingness to invest because the transactional costs involved will be increased.

Viewing the above, the no-restriction approach may not be appropriate in the case of Telecom industry. Rather, a foreign ownership limit of just less than a majority is preferred to ensure adequate competition in the liberalized segment of Taiwan's telecom market through new foreign ownership in market entrants. A higher foreign ownership limit would not have been politically correct. Many LY members and policy makers supported this contention and their logic was that, due to the diffusion of government monopoly, the local firms should have the first, or at least a larger, bite at each liberalized segment. Foreign ownership in Telecom is welcomed under their proposition, but only to the extent necessary to induce foreign shareholders to supply the needed technology and capital. Further, many members of both the ruling party and the opposition party contemplate that Telecom is too much of a strategic industry. Hence, a higher foreign ownership limit should not be permitted. This writer endorses this view, as limited protection must be in place to achieve two ends, i.e., any new bill must concurrently promote the local Telecom industry and to maintain sufficient local interests until the local contingency has sufficient strength and know how for complete liberalization.

[27] Hereinafter referred to as "SBTL". The SBTL was drafted and tendered to the EY for deliberation in September 1995.

[28] See Lawrence S. Liu, *Issues in Debate on Regulating Satellite Television in Taiwan*, 18 East Asian Executive Reports 8 (1996).

[29] Please refer to part 6.6 for a more detailed discussion on SBTL, relevant laws and related issues.

[30] Hereinafter referred to as the "GIO".

[31] Remarks by Paul France of ABA at a seminar on Telecom liberalization in the Asia-Pacific region, held in Taipei on November 23, 1995. According to him, the ABN would have chosen Hong Kong, but for its prohibition of majority foreign ownership in satellite broadcast and television.

[32] At this point, it seems that CHT takes the position of one-way interconnection with CHT for pricing/billing purposes. In addition, how would CHT reconcile its interconnection obligations with its pronounced profit-making objectives is another important competitive parity issue. Two observations are relevant. First, even though the new DGT should play the

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role of an independent arbiter, this would be easier said than done. Some adversarial proceedings involving the MOTC or the Fair Trade Commission (hereinafter referred to as the "FTC") may be necessary. Second, in addition to the general obligations governing interconnections under the amended TL, the CHT Law also provides that CHT shall maintain reasonable tariffs. This CHT-specific requirement is compatible with the argument of a cost-based, non-biased interconnection principle. Similarly, a type I operator under the TL is prohibited from subsidizing its type II business. Less clear is whether a type I operator may cross-subsidize different (Such as fixed line versus mobile communication devices).services which are all type I businesses. However, such cross subsidization should not be allowed for three reasons. First, the spirit of the 1995 revised bill that led to the TL amendment suggests that such cross-subsidization should be prohibited. Second, support can also be drawn from the policy underpinning the TL amendment, which is the APROC Plan. The Plan certainly would support a pro-competitive approach and therefore, would not accept predatory practices. Third, the Fair Trade Law (hereinafter referred to as the "FTL"), which has yet to apply to the telecom market, suggests that such cross-subsidization could constitute predatory action by the dominant firm.

[33] Details on how contributions to this fund should be made will be developed after the mobile telecom market opening program, as discussed below.

[34] The amended TL also specifically prohibits telecom companies from discriminating against their customers. This anti-discrimination requirement could be interpreted literally. However, a more enlightened interpretation would be to follow the same prohibition in the FTL, which requires such differentiated treatment to be justifiable, thereby allowing a "rule of reason" line of defenses for telecom companies.

[35] The TL also contemplates some liberalization in the tariff. First, for type II telecom businesses, the tariff is completely deregulated as this segment follows the competition policy. For the type I industry, a major tariff will be adopted by the DGT subject to the MOTC's concurrence. A secondary tariff for type I businesses will be determined by the DGT itself. Importantly, the TL, even as amended, still provides that the tariff formula should be approved by the LY. In other words, even though some competition will be introduced into the type I industry, there will still be some legislative oversight as if the natural monopoly utilities model still applied. The LY review of the tariff formula promises to be a politicized process and as will be discussed below, the imminent entry of new mobile telecom operators already presents some policy issues in this area.

[36] The TL also provides DGT with the authority to collect fees for assigning radio frequencies. In other words, the auctioning-off of frequencies is a possibility in the future. However, because there has not be an assessment of the aggregate use of frequencies (particularly where the frequencies are deployed for military uses) and the intricacy of such an exercise, the MOTC/DGT has opted for the traditional merit-review licensing approach for the mobile telecom market opening program of 1996.

[37] The CHT Law bill was the most contentious of the three telecom reform laws adopted in 1996, because its implementation would have a major impact on the autonomy of CHT and the job security of its employees. Indeed, not only were the unions of CHT becoming vocal; so were the unions of other state-owned enterprises such as Chinese Petroleum Corporation and some state-owned banks.

[38] One of the demands of the DGT employees was that their representatives should become members of the board of directors or supervisors. To support their contentions, the DGT employees cited the German co-determination, labor participation legislation for large enterprises and a similar arrangement at France Telecom, which was also undergoing privatization at the time. During the final LY negotiations in mid-January 1996, a compromise-albeit what it meant was less than clear-was reached so that under the CHT Law, one-fifth of CHT's board of directors would be "experts." Presumably, labor representatives were considered "experts." However, the ruling party and MOTC/DGT have resisted such an interpretation of this provision. Since the corporatization of CHT, all its board directors have been appointed by the government, and there has been no labor representation. However, in the re-election for CHT's union leadership in October 1996, those that strongly opposed management received more support. The increasingly vocal CHT union leadership will make transformation of the CHT more difficult and could affect its behavior in the marketplace. Even though the business and regulatory functions of the new DGT and CHT now have been divided, policy makers still serve on the CHT's board of directors. This situation makes avoiding conflict of interest more difficult. On the other hand, the presence of policy makers on CHT's board of directors would ensure more direct influence over its various constituents within the CHT, such as senior management and union leadership.

[39] The chairman of CHT's board of directors and other directors nominated by the government as owner, must be civil servants. This requirement could preclude CHT from recruiting experienced business leaders to serve on its board, a reality for state-owned enterprises. The original CHT bill of 1994 had provided that the chairman would have to be experienced in the telecom business. This requirement was eliminated in the final negotiations as some LY members thought the experience requirement was unnecessary and even potentially abusive as it would have favored incumbents. The CHT Law provides for significant protection of employee welfare, as employees' civil servant status has been maintained. Meanwhile, this law also allows CHT to recruit new employees who would not be civil servants, so that hopefully the corporate culture at CHT will gradually reflect its status as a semi-privatized entity. This dual personnel system is a breakthrough for state-owned enterprises in Taiwan. Indeed, when the provision was proposed originally in 1994, it was vehemently opposed by the Examination Yuan.

[40] In addition to job security, under the CHT Law employees at CHT are given preference in the offering of any ownership diversification program that the government conducts for its holdings in CHT or for the issuance of new shares. This treatment is similar to that under the Statute for Privatizing State-Owned Enterprises (hereinafter referred to as the "Privatization Statute"), which was amended in 1990 as a result of lobbying by employees of state-owned enterprises. The Privatization Statute, however, may not adequately address issues arising from massive share diversification programs such as those involving CHT, Taipower, and Chinese Petroleum Corporation. There is now a new thinking among policy makers and advisors to the Taiwan government that a much wider distribution of shares of telecom companies to citizens would be advisable for efficiency as well as social justice reasons. Union activists at CHT do not believe the state is a legitimate shareholder. To the contrary, their demand for board representation belies their conviction that the employees of CHT are the driving force behind CHT's success and as such, are the true "stockholders" at CHT. Therefore, it would behoove policy makers in Taiwan to create legitimate ownership, by allowing its millions of telephone users, who have paid hefty installation fees over decades, to be shareholders of record. However, mere diversification of ownership through underwritten offerings may not be enough to galvanize CHT. As indicated above, outright privatization as a shock treatment has been ruled out as a politically unpalatable proposition. In the alternative, perhaps some thought should be given to transforming the bureaucratic culture at CHT. This may be achieved by arranging for a strategic sale to one or several international telecom companies.

[41] Another important breakthrough in the CHT Law was the provision adopted to unshackle CHT from the "prior audit" requirement imposed upon the old DGT. This requirement of the Control Yuan (hereinafter referred to as the "CY") is rather unique in that audits by definition should occur after the closure of the fiscal year. However, the CY, as one of the five branches of government in Taiwan that exercises oversight and impeachment power over activities of agencies and state-owned enterprises, administers the Audit Statute which contemplates such prior audits. Despite this legislative reform, old habits promise to persist. However, CHT still seems inclined to submit to prior audits in order to prevent their procurement procedures and other similar decisions from being second guessed by the Audit Ministry of the CY. Although some policy makers and indeed, employees of the old DGT had argued that CHT should be freed from all government oversight, and from budget review in particular, this argument was not accepted and did not even make its way into the original CHT bill. Under the Taiwan's Constitution, the Budget Law, and related legislative practice, the LY's budget review power has always extended to state-owned enterprises. The LY's power to review, though, occasionally runs counter to the public corporation's best interests. For example, the new LY session for the first half of 1996 did not approve the budget of state-owned enterprises in time. As a result, all state-owned enterprises ran on the basis of the previous year's budget. In an effort to maintain stability, CHT has only made cosmetic internal changes thus far. Its corporate management structure still

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has too many layers, and streamlining would create internal personnel problems. Its budget for fiscal year 1997 does not distinguish between type I and type II business costs and revenues, nullifying the TL prohibition against cross-subsidization. Although CHT claims that it only had a few months to prepare this budget between the enactment of the three telecom reform bills and its incorporation, whether a better job at preparing the fiscal year 1998 budget will be made remains to be seen. The prospect for tightening up CHT's capital budgeting and financial management is not promising. Such inadequacies will have a significant impact on its competitive behavior and the government policy for further opening the telecom market. For example, as a state-owned enterprise, CHT is not subject to generally accepted accounting principles or auditing standards applicable to private companies in Taiwan. Therefore, the integrity of its accounting system and transparency of its cost structure is questionable. CHT has virtually no debt, but is unlikely to be able to maintain its debt-free status for long. In the future, CHT will come under constant pressure to better use its borrowing capacity. In addition, as the burden on the Taiwan government to fund welfare programs increases, there is even more pressure to siphon off after-tax earnings[41] from CHT. Finally, CHT's capital account has relatively low paid-in capital and but a bloated capital surplus, all on a historical basis even though an asset revaluation would increase its net worth several times. The relatively smaller paid-in capital was designed in a way to circumvent a statute adopted in the 1930's governing contributions to employee welfare funds, which would require a significant initial contribution on the basis of the paid-in capital. This artificially low paid-in capitalization will not be conducive to any massive public offering in the future as the offering price per share would be too expensive.

[42] The CHT Law allows CHT to enter into other businesses as approved by the MOTC. This provision represents an acknowledgment by the old DGT that its successor corporation would have to diversify. However, this provision signals potential threats to companies in other markets. Where the boundaries between traditional markets such as cable television and Telecom are becoming less and less easy to distinguish, the concern for competition, and indeed fair competition, has increased.

One concern of CATV operators in Taiwan is that CHT is permitted to enter the cable television market, but the CATV operators are not allowed to enter the Telecom market. Their fears may be justified because a unique provision was inserted by the DGT into the Cable Television Law. (The Cable Television Law was adopted in 1993 to legalize the CATV industry, also know as the "Fourth Station" because they operated illegally in competition with the three legal terrestrial television stations owned by or affiliated with the government). Amazingly, this provision would disqualify any applicants seeking a CATV operator's license if it engages in "the business of the DGT."

Clearly such a provision was not necessary even under the TL of 1958, because it had contemplated a government monopoly such as the DGT. The intention of this provision, therefore, was plainly anti-competitive; it appears to block future entry into the Telecom market by CATV operators. Interestingly, now that the business unit of the DGT has been privatized as CHT, and the DGT is only a regulatory agency after the TL amendment in 1996, the disqualification in the Cable Television Law based on engaging in "the business of the DGT" does not make any sense. Whether it is prudent to reinterpret this provision in light of the gradual market opening or repeal it outright requires some thoughtful policy formulation.

In any event, the MOTC should be circumspect in allowing CHT, a formidable player in any new market despite its constraints as a state-owned enterprise, to enter any new market. From a national policy perspective, the CEPD should not be stagnant while the MOTC makes up its mind on this issue. To be sure, the LY will also use its budget-review power to monitor CHT's competitive strategies in new markets.

[43] Another regulatory and competitive parity issue relating to CHT is whether it had to be re-licensed to engage in the telecom business. As a state-owned enterprise, it would be in the public interest to re-license CHT to continue the business of the pre-corporatized DGT. Thus, CHT was re-licensed. However, what should have been addressed was the broader issue of whether any constraints should be imposed on CHT in connection with such re-licensing to provide a fair chance for the private-sector entrants to compete.

[44] Such as the MOTC and then the EY.

[45] Such as the DGT.

[46] Members of the committee are appointed by the EY.

[47] *Supra* p.3.

[48] As of 13 January 1997, eight licenses were granted for the operation of two types of mobile phone service, i.e. DCS and GSM. Six winners were selected by MOTC from 29 contending companies. Most of the 29 companies are joint-ventures between local groups and foreign companies from Europe, Asia and North America. For more details, please refer to Table II. Regarding the licenses of the paging service, 32 applications were filed by 19 companies and MOTC granted 8 licenses to the 8 private winners on 30 January 1997. For details, please refer to Table III.

[49] The award of trunking radio licenses was announced through open bidding on 20 May 1997 and 20 licenses were awarded to 14 business operators. Please also refer to Table IV for details. The trunking radio license award concludes the prelude of Telecom liberalization in Taiwan and arguably the experience derived may be beneficial for further deregulation.

[50] See "Kon Shan Hourly News", May, 20th, 1997, page 21.

[51] Hereinafter referred to as "QFII".

[52] Hereinafter referred to as "SEC".

[53] *Supra* note 23, page 8.

[54] Taiwan is an island of which 75% is covered by mountains and hillsides.

[55] *Supra* note 23 page 9.

[56] Applicable legislation include:

1. Broadcast and Television Law, which regulates broadcasting and television in general and is enforced by the Government Information Office;
2. Cable Television Law, whose enactment was sponsored by the GIO to legalize the de facto CATV industry that mushroomed after 1988;
3. Telecom Law;
4. Publication Law, which is an older stature that applies to print media; *and*
5. Fair Trade Law, adopted in the early 1990's, embodies Taiwan's recent policy shift towards competition policy and competition rules, although its application in this field is still largely untested.

[57] *Supra* note 23 page 21.

[58] Such as the Broadcast and Television Law, Cable Television Law or Telecom Law.

[59] Article 4 of the SBTL.

[60] Such as programs which violate laws or regulations detrimental to the welfare of minors or contravene public order and good morals as stipulated in Article 15 of the SBTL.

[61] Penalties in the form of pecuniary fines are most often imposed.

[62] Article 28 of the SBTL.

[63] The license duration is sex years and renewable.

[64] Article 6-14 of the SBTL.

[65] Responsible persons in Taiwan usually refer to as the managing director.

[66] Article 13 of the SBTL.

[67] Article 18 of the SBTL.

[68] Which also includes the Taiwan strand.

[69] See "Judging the Judge", Asian Wall Street Journal (October 12, 1995).

[70] *Supra* note 23 page 22.

[71] *Ibid.*

[72] *Ibid.*

[73] *Ibid.*

[74] *Ibid.*

[75] *Ibid.*

TABLE I TELECOM MARKET OPENING TIMETABLE

Fixed Network Service

Business	Timetable	Note
Local Telephone	July 2001	Including the opening of digital communication business;
Domestic Toll Telephone	July 2001	Including the opening of digital communication business.*
International Telephone	July 2001	Including the opening of digital communication business.*
Leased Circuit Service	July 2001	Lessee can not merely act as the agent for recording services.*
Wide-band Service	July 2001	For digital operation, Operators without unified transmission network equipment and establishment are classified as Type II operators.*
Data Transmission Service	July 2001	Operators without unified transmission network equipment and establishment are classified as Type II operators.*

* the actual number of operators permitted is TBD depending on market demand.

Satellite Communication Service

Business	Timetable	Note
Satellite TV Broadcasting Links Service	Dec. 1996	25 Operators
Mobile Satellite Service	Dec. 1999	The number of Operators is TBD
Fixed Satellite Service		

Wireless Communication Service

Business	Timetable			
Public CT-2	Nov. 1994	900 MHz:	Northern:	3
			Central:	3
			Southern:	3
Cellular Mobile Phone	Jan. 1997	900 MHz:	Northern:	1
			Central:	1
			Southern:	1
		1800 MHz:	Northern:	1
			Central:	1
			Southern:	1
			Island-wide:	2
Radio Paging	Jan. 1997	285 MHz:	Northern:	2
			Central:	2
			Southern:	2
			Island-wide:	2
Trunking Radio	Mar. 1997	500 MHz:	Northern:	4
			Central:	4
			Southern:	4
			Island-wide:	1
		1800 MHz:	Northern:	2
			Central:	2
			Southern:	2
			Island-wide:	1
Mobile Data	Mar. 1997	500 MHz:	Northern:	4
			Central:	4
			Southern:	4
			Island-wide:	1
		800 MHz:	Northern:	1
			Central:	1
			Southern:	1
			Island-wide:	1

Source: Execution Yuan Gazette, Volume 2 ,Issue 51

TABLE IIMOBILE PHONE LICENSEES, 1997

Type	Area	Winner of the license	Foreign partners
DCS	Nation wide	Pacific Communications System (Pacific Electric Wire & Cable Group)	GTE
	Nation wide	Far Eastern Telecom Co., Ltd. (Far Eastern Group)	AT&T
	Northern Taiwan	KG Telecom Preparatory office (Koo's Group)	Sprint
	Central Taiwan	Smark Link (Tuntex Group)	First Pacific
	Southern Taiwan	Smark Link (Tuntex Group)	First Pacific
GSM	Northern Taiwan	Far Eastern Telecom Co., Ltd. (Far Eastern Group)	AT&T
	Central Taiwan	Mobitai Co. (TECO Electric & Machinery Group)	De-Te-mobile Sumitomo
	Southern Taiwan	TransAsia Telecom (TAT) (Asia Pacific Investment Co.)	Southwestern Bell Co.

Source: compiled by the author from various sources.

TABLE III PAGING LICENSEES 1997

Area	Winner of the license	Foreign partners
All distance	First International Pager Service Corp.	
	Chung Hwa International Paging Co., Ltd.	
Northern Taiwan	Express Link Ltd.	HK ABC
	Taiwan Mobile Communication	IWC
Central Taiwan	Hsun Ta Telecom	
	Taiwan Mobile Communication	IWC
Southern Taiwan	Southern Telecommunications	Telia Ucom
	Chang Jung Telecom	

Source: compiled by the author from various sources.

TABLE IV TRUNKING RADIO LICENSEES

Frequency	Licensee		Major Shareholders	Facility
800 MHz	All Areas	Lianbang Co., Ltd.	Chunglien Transportation Co., Ltd.	Telecom Co., Ltd.
	Northern	Advanced Telecommunication, Inc.	Advanced Scientific Corp.	Tait
		ADI Communications Corporation	Meng Chaonien	ADI
	Central	Advanced Telecommunication, Inc.	Advanced Scientific Corp.	Tait
		ADI Communications Corporation	Lia Chicheng	ADI
	Southern	Huawei Telecommunication Co., Ltd.	Huang Peiyuan	Tait
		Data Telecommunication Co., Ltd. Sugui Telecom	Kaohsiung Bus Co., Ltd.	CKT
500 MHz	All Areas	Freedom Telecommunication Ltd.	Tajung Transport Co.	Tait
	Northern	Taichong Telecom.	MSI International Corp.	Nokia
		Fleetpro Telecommunications, Inc.	Hsinchu Trucking Co., Ltd.	Tait
		Simple Telecommunications Corporation Preparatory Office	Prince Motor Ltd.	JRC
		Beiyun Telecom.	Micro Electronics	Motorola
	Central	Fleetpro Telecommunications, Inc.	Hsinchu Trucking Co., Ltd.	Tait
		Simple Telecommunications Corporation Preparatory Office	Prince Motor Ltd.	JRC
		Bestway Technology Co., Ltd.	Hsinke Telecommunications	Nokia
		Leephone Telecommunications Inc.	Leephone Transportation Co.	Motorola
	Southern	Fleetpro Telecommunications, Inc.	Hsinchu Trucking Co., Ltd.	Tait
		Simple Telecommunications Corporation Preparatory Office	Prince Motor Ltd.	JRC
		ADI Communications Corporation	Lia Chicheng	ADI
		Phantai Telecommunication Inc.	Chiehfu Co.	Nokia

Source: MOTC

TELKOM's Approach to Integrate Service Management Into Integrated Management System (IMS) to Face a Converging World

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1. ABSTRACT

The requirements for the operational organizations of telecommunication business are more complex than most business. To face competition era of telecommunication business, telecommunication providers must provide the best services to customers. To improve the customer service quality, PT. TELKOM has an approach to integrate the Customer support system into TELKOM's Integrated Management System as one of functions in TMN service management layer.

2. BACKGROUND

In today's environment, nothing is more important than customer service. With competition comes choice, and fortunes await the provider who excels at treating customers as partners. Therefore, the heart of telecommunications business are customer care processes, its operational support systems, and its linkages between customer service offerings and underlying networking assets.

The Indonesian telecommunications network of the 90s and beyond will be one of multiple networks connected to PT. TELKOM and regulatory agencies. These organizations will provide the glue that allows their customers to do business in the manner that they want. There are different levels of Customer Support Systems (CSS) exist in Indonesia with some being manual and others computerized.

To accomplish TELKOM goal as world class operator in 2001, TELKOM must achieve new levels of integration among all systems - across vendor boundaries, even across national with cost-effective ways. Automation and standardization of CSS is a key success factor that should be implemented.

For this reason, the Integrated Management System provides the power to accommodate today's need with the future in mind, and thereby enable future technologies to cooperate and inter-operate without artificial restrictions.

This paper gives a brief description about strategy of TELKOM to integrate CSS into IMS. The first part describes about TELKOM's IMS, the second part describes about existing CSS, and the third part describes TELKOM approach solutions for reengineering service management need to integrate the CSS into IMS.

3. TELKOM's INTEGRATED MANAGEMENT SYSTEM (IMS)

In 1993 TELKOM adopt the Telecommunication Management Network which is expected to achieve optimum availability and control of the entire network and have capability to monitor the performance of the entire network. The prime infrastructure of the network management function is the Integrated Management System (IMS) that is expected to be capable for achieving certain functions of the ITU-T as per draft recommendation M.3010 include fault management, configuration management and performance management.

The Integrated Management System (IMS) is centered on the National Network Control Center (NNCC) that carries out surveillance of the overall network and transmission backbone. 5 Regional Network Control Center (RNCC) are connected to the NNCC and carry out surveillance of switching in each region. The operating system that used to integrate various type of switching is MFOS (Multi Function Operating System).

TELKOM has a planning to develop IMS which providing network management functions to enhance network performance and help achieve TELKOM'S World-Class service quality objectives. Integrated Management System (IMS) designed to improve the operational management, service management, reduce cost, thus improving profitability.

IMS Development Strategic Plan is focused on providing the integration strategies required insuring optimum utilization of this system. The considerations which used to improve the IMS / TMN are activities of five business Processes, those are Network Operations, Customer Support System, Engineering & Planning, Accounting, and Corporate Support Systems.

Those business processes reflect the TELKOM's vision, strategy, organization, and company culture as a World-Class Operator in 2001. The implementation of those business processes based on the five-management layer concept that included on ITU-T M.3010.

In integrating the five business processes, the implementation is divided into three stages. The first stage starting from 1993 to 1997 is optimization of the existing system and network operation. The second stage starting from 1997 to 2000 is a continuation of the first stage and customer contact service, engineering and network planning, and accounting system. And the third stage is a continuation of the second stage and corporate support system.

As a target shown in second stage (1997 - 2000), customer contact services become an important aspect that is considered to be integrated into IMS.

4. EXISTING CONDITION OF CUSTOMER SUPPORT SYSTEM

Different levels of CSS exist at the Kandatel level, with some being manual and others computerized. Each Kandatel stands alone operating autonomously from others, and as a result standards, data, methods, and procedures are not always implemented consistently. The manual CSS operation is still implementing in some small Kandatel or Kancatel and rural service area. The process of manual CSS has a same process flows with the computerized. Number of Kandatel or Kancatel that implementing manual process is not too many. Most of Kandatel have been implementing the computerized CSS.

Customer Support System application that has been implemented so far in TELKOM is SISKA (*Sistem Informasi Kastemer* or customer information system) / SISKAMAYA (*Sistem Administrasi Kabel dan Manajemen Pelayanan* or cable administration and service management system). SISKA/SISKAMAYA is containing the information necessary for service provisioning and customer billing.

Although there are various SISKA/SISKAMAYA version, but basic function that already applied are cable administration, fault administration, and service administration.

Cable network computerization System is a system that function to execute establishment, renovation and maintenance of cable network database and that database utilization for telecommunication services necessity.

Cable network administration system has some objectives, which are: straighten up and take inventory local cable network data, create data uniformity at any working unit through centralized cable network database establishment, accelerate interposition work information and document flow and minimize paper document usage, shorten service time, facilitate status and process monitoring at any working unit, and facilitate to make report and statistic analyze to management and planning necessity.

Fault administration (117) deals with the handling of trouble reporting by customers to the 117 operator. Existing repair process is shown in figure 1.

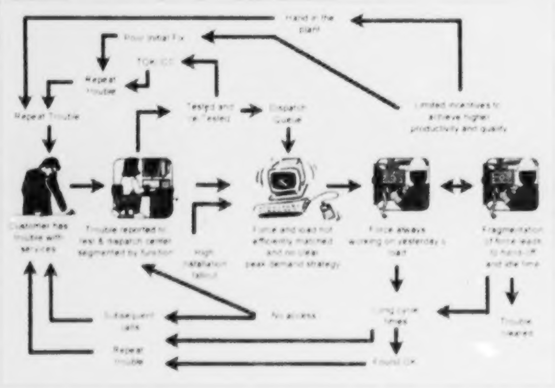
Hand in the plant
Poor Initial Fix
TOK ICT
Repeat trouble
Repeat Trouble
Tested and re-Tested
Dispatch Queue
Limited incentives to achieve higher productivity and quality
Customer has trouble with services
Trouble reported to test & dispatch center segmented by function
High installation fallout
Force and load not efficiently matched and no clear peak demand strategy
Force always working on yesterday's load
Fragmentation of force leads to hand-off and idle time
Subsequent calls
No access
Long cycle times
Trouble cleared
Repeat trouble
Found OK

Figure 1 : Existing trouble handling

Service administration provides functions i.e. perform new connection offer and mutation services, monitoring applications in process, acceptance of customer applicant, services application cancellation, waiting list menu, see telephone number ready to sale, etc.

The newest version of SISKA is SISKA phase-2, which has functionality better than the previous version. Its system specifications are: consists of a number of integrated and independent modules, provide multi-user access, on-line updating system, and utilize remote login function.

SISKA phase-2 application generally divided into three parts of module, they are technical Management Module, financial Management Module, and Commercial Management Module.

Technical Management Module provides network management function, and work force management function. Financial management module consists of billing function, customer accounting and payment process. Commercial management module provides customer management function, request management function, directory service, fault management, and call data collection.

Regarding to all of features which has been implemented, there are some other features that have not been completely provided. The desired status features and need to be developed are functions for fiber access network, integration with other services (IN, ISDN, etc.), billing applications for various services (IN, PSTN, etc.), integrated modules (technical, financial, and commercial).

5. INTEGRATION CSS INTO IMS

The requirements for daily operational organizations of telecommunications business are more complex than most business. The operations involve continual monitoring of the status of a lot of components. In addition, the organization must manage installation and troubleshooting schedule, collect usage data then process it, plan for current and future demands, and maintain efficiency.

For this reason, the IMS provides the power to accommodate today's need with the future in mind, and thereby enable future technologies to cooperate and inter-operate without artificial restrictions.

5.1. CSS Functionality

The explanation below identifies CSS that need to be integrated with the IMS to provide the functionality required by an efficient telephone.

5.1.1. Front Office

The Front office is a crucial part of the overall customer process methodology supported by the IMS. Most face to face customer contact occurs at this location. Therefore, it is critical that individual customer data be made available to Front Office personnel. A fully functional IMS is the perfect tool to provide current interactive data.

Front Office will be responsible for meeting the demands of business and / or residence customers, via on-line transactions directly linked into the IMS, regarding new installation, changes, moves, shifts or disconnection of existing services. It provides support to all work groups involved in the back office process, as well as repair and sales and marketing.

The IMS will integrate the Front Office one stop services with access to the following sub-systems, which are order handling, billing, local Plant Records, fault handling and testing resolution, field work force management, report generation and management information, customer complaint handling, and interfaces to other systems.

The figure below describes about IMS front office one-stop services.

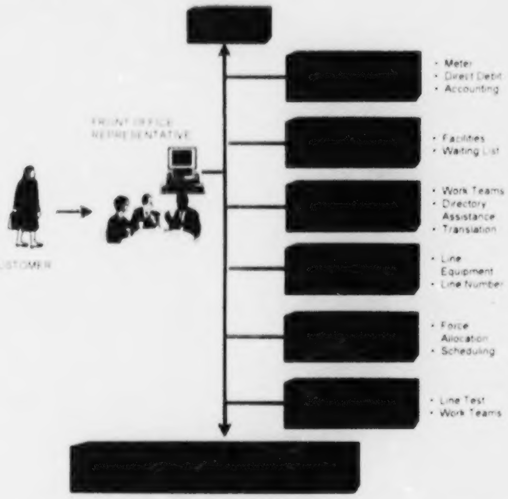

Figure 2 : IMS Front Office One-Stop Services

Billing inquiries, collection of overdue accounts, sales of various products and services, complaint resolution, referral of faults, answering of general questions, and electronic mail and public provision of company policy can be made accessible through the IMS.

Service orders input into the IMS will be generated and processed automatically in the system and distributed electronically to the network provisioning mediation device of the exchange switch. The service order creates the customer database which in turn will become the basis for the customer history file, directory data and listings, billing data, administrative reports, customer facilities (cable/pair/number) and fault reports.

To speed up the service order process, the Front Office will be directly linked by computer to the mediation device. The service order process should

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be completely automatic including service provisioning. When the provisioning fails due to unavailable facilities, improper address, or billing problem the customer will be immediately notified and the order routed to the Back Room.

Services provided by the Front Office supported by IMS are sales of services, provisioning of services, complaint resolution, and order handling.

Sales of services cover services, which are : types of service options and customer equipment, help customers choose the most economical and efficient service to meet their needs, discuss service rates, provide a help desk for customers requiring more complex services, discuss billing options and cycle with customers, take customers orders and determine installation schedules, as well as identify sales promotion.

Provisioning of service has functions to manage installation or change and deactivation of services, input of service orders into IMS, distribution and tracking of services orders to plant forces, scheduling of installation dates as set by installation work force, education of customer regarding bill payment at time of the installation, post service activity, provides a response via a referral process to service faults and failures, escalate faults to the responsible groups, provides answers to billing inquiries and complaints, provides answers to general inquiries and complaints, perform collection activity, maintain help desk function for more complex services and faults, and up sells to customers with existing service.

Complaint resolution provides functions to manage status of customer complaints, matters relating to pre and post service provisioning, management functions, customer database management, support to other groups, report administration, development and training.

The IMS will allow Front Office staff to make inquiries of information held in all the sub-system. Security and levels of access will be determined through network operator agreements. One of the various sub-system is order handling which is concerned with the establishment, changing or termination of service to a customer. The system will allow service orders to be entered on-line by Front Office staff located at centralized Customer Service Centers.

It will automatically allocate a number from the list of available numbers held in the system, and will be capable of determining the correct local distribution point for the new subscriber from their address. Then it can optimize the path between exchange and distribution point using the local line plant records and, allocate the appropriate line plant.

The order handling modules maintains the information, i.e. customer details data, service and equipment features, plant and maintenance, main station, special details (about discount rates, taxes status), support of route-specific rating and directory assistance, and billing and payment history.

5.1.2. Back office

The Back Office provides all the support systems to assist in the day to day operations of the company. The IMS will allow sharing of vital data across multiple organizations allowing for rapid changes to daily workloads, identification of facility and plant problems and on-line updates of all databases.

a. Billing

Its functionality can be divided into primary areas, which are : entering and updating information for customer accounts, collection of billing data, processing of billing data, interrogation of customer bill information to answer any customer billing inquiries, correcting and editing customer information and billing data.

An important aspect of billing system is to ensure that the data within the system is accurate. The billing system must provide sophisticated verification procedures in order to ensure that its customers are protected from the problem of inaccurate billing data. This is achieved through special software routines in the network interface and operator input modules, which intelligently verify data as it is received.

The IMS network interface controls all the communication between the billing system and the network switches. The physical interface, based on CCITT-defined standards, is handled by the Mediation Devices. The Mediation Devices handle the different data formats from major switching system manufactures.

Connection between the switches and Mediation Device are based on protocol X.25. All customer-related information is maintained in the master contained within the Billing System. From this database the Billing System will generate a series of work orders, or tasks, for connection, disconnection, and other supplementary services. These are processed by the Mediation Devices, which update the network switches.

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b. Local plant record

This sub-system is concerned with holding a full record of the external plant available and is used in the access network and remote stations, including buildings' distribution systems.

The system allows details of the remote stations to be stored including available numbering ranges and MDF termination points. It also stores details of the external line plant so that work lists can automatically be generated for external plant provision and repair activities. The system allows bulk moves of exchange and line to be made.

c. Trouble handling

This sub-system deals with the handling of troubles reported by customers. The system allows details of the reported trouble to be input on-line through a VDU into the Administration System, at the same time as the customer reports the trouble. It supports the initial analysis of the trouble by the operator and automatically triggers a suite of line testing to further diagnose the cause of the trouble.

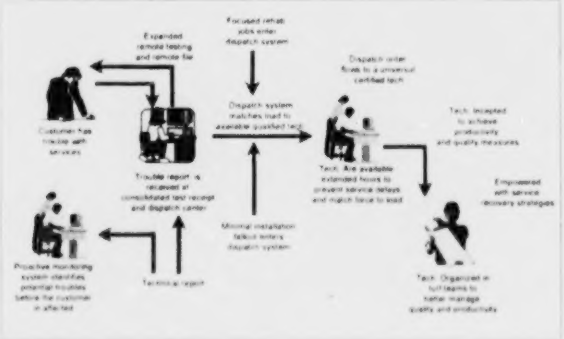
Expanded remote testing and remote fix
Focused rehab jobs enter dispatch system
Dispatch order flows to a universal certified tech
Customer has trouble with services
Dispatch system matches load to available qualified tech
Tech. Incented to achieve productivity and quality measures
Trouble report is received at consolidated test receipt and dispatch center
Tech. Are available extended hours to prevent service delays and match force to load
Empowered with service recovery strategies
Minimal installation fallout enters dispatch system
Proactive monitoring system identifies potential troubles before the customer is affected
Technical report
Tech. Organized in turf teams to better manage quality and productivity

Figure 3 Trouble Handling With IMS

d. Work force management

This sub-system assists the installation and maintenance management staff in the management of the field work force. The system maintains work-lists for each of the field units and is able to book appointments in their daily schedules. It is able to run jobs, in sequence, allocating new jobs when the old ones have been completed.

e. Reporting

This sub-system is concerned with the production of management statistics and progress information. The system is capable of generating the statistics required for overall performance indicators. It is also able to generate management reports and marketing information based on the types of customer served.

The system is capable of interfacing either directly, or by magnetic tape, to other system i.e. directory inquiry systems to provide updates to customer records, accounting ledger for the production if accounts, call data collector for access to exchange call data, operator-connected call information, and banks and other clearing houses.

The accumulation of this data allows for the end user to draw day to day operational reports, identifying monthly and yearly trends, and weekly spots within the organization.

5.2. Customer Support System Functional Architecture

Figure 4 depicts the basic customer support system interrelationships, which are required to provide service and billing to the customer.

Billing Services that process usage data from NE provides functions for processing of payments, generation of bills, and maintenance of customers bills.

Network Resources Assignment has functions for provides service requests, and assigns inventory records.

A Customer contact representative can identify and resolve most of the problem and service request given by the customer while the customer is on the line. If the problem can not be resolved immediately the representative can usually identify where the problem is and gives an accurate estimate of when the problem will be resolved.

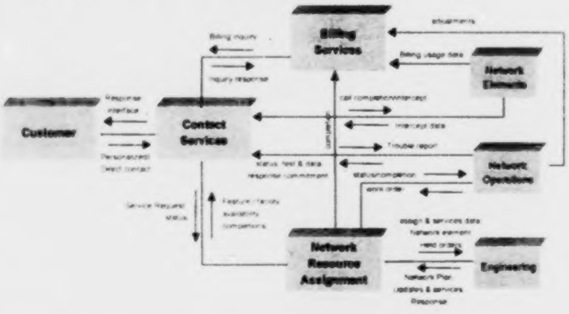
Billing Services
adjustments
Billing inquiry
Billing usage data
Inquiry response
Network Elements
Customer
Response interface
Personalized Direct contact
Contact Services
call completion/intercept
Intercept data
Trouble report
status, test & data response commitment
status/completion
work order
Network Operations
Service Request status
Feature / facility availability completions
design & services data
Network element
Network Resource Assignment
Engineering
Network Plan updates & services
Response

Figure 4: Customer Support System Function

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5.3. Functional Architecture of integration CSS into IMS

The figure below describes the functional architecture of integration CSS into IMS.

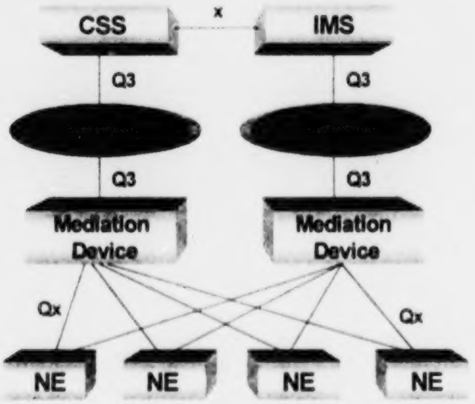

Figure 5 : Architecture Of Integration CSS Into IMS

For the sake of integration, TELKOM has a commit to standardize about its common interface and its database that contains all information about service provisioning and billing. Database system and its support function will be integrated into one of integrated system.

Based on the above figure about architecture of integration CSS into IMS, the interface that need to be standardized are X interface for CSS and IMS interconnection, Q3 interface that used for connection between Operating Support System to DCN and between DCN to Mediation Device. Otherwise Qx interface is a proprietary vendor's interface.

6. CONCLUSIONS

There are different levels of Customer Support System (CSS) exist at Kandatel level, with some being manual and others computerized. SISKA, SISKAMAYA are the current computerized Customer Support System (CSS) that TELKOM has in place to meet world class service standards.

The existing CSS in each Kandatel is stand alone operating autonomously from others, and it has not optimally used to support operational and managerial activities.

The Integrated Management System (IMS) provides the power to accommodate today's need with the future in mind and thereby enable future technologies to cooperate and inter-operate without artificial restrictions.

The integration of CSS into IMS, as TELKOM focus on 1997 – 2000, will result a smooth flows among systems, and become a source of information for the corporation, and a reference for the engineering the expansion of the network.

For the sake of integration, TELKOM has a commit to standardize on its common interface and its database that contains all information about service provisioning. Database system and its support function will be integrated into one of integrated system.

Such integration will provide the accurate, on-demand data needed to run day-to-day operations and to project future requirements, and furthermore it will support TELKOM's target to meet world class operator in 2001 and to face a converging world.

References

(1) *Fundamental Technical Plan*, TELKOM, 1996.

(2) *TELKOM Master Plan of Integrated Management System*, 1995.

(3) Uyless Black, *Network Management Standards, Second Edition, Mc. Graw Hill*, 1995.

(4) *TMN Laboratory Guide for PT TELKOM*, DIVRISTI, Version 1, October 25, 1996.

Cable TV and Telephony Convergence in Taiwan

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1. ABSTRACT

With a high cable TV penetration rate and modern telecommunications network, a comprehensive Cable TV Law, new legislation which will liberalize telecom, and an aggressive plan for its National Information Infrastructure, Taiwan appears ripe for implementing cable TV/telephony convergence. Though many cable TV networks still lack modern transmission infrastructure, the small cable operators are now joining forces to amass sufficient combined resources to support the modern technology for convergence. But cable TV is regulated by one agency, telecommunications by another independent organ; the difficulties for establishing and coordinating convergence policy are obvious. Even as it tries to address the regulatory obstacles, Taiwan is going forward with broadband network pilot projects to overcome technological barriers. There is an excellent opportunity to add convergence-related products to Taiwan's long list of successes in the production of information technology hardware.

2. CABLE TV/TELEPHONY CONVERGENCE

What is convergence? Cable TV is one-way, non-switched, broadband broadcast; whereas telephony is two-way symmetric, switched, narrow and wideband voice or data service. Convergence is the integration of the co-existing symmetric and asymmetric, switched and non-switched, and narrow/wide/broadband technologies to provide communication services of voice, data, video conferencing, and videophone, in addition to the array of broadband multimedia broadcast services. These multimedia services will include entertainment -- analog and digital broadcast, pay-per-view, near-video-on-demand, video-on-demand, interactive games; information -- news, travel information, weather; transaction -- home shopping, home banking; distance education; and telemedicine. Cable TV and telephony convergence is also one of the proving grounds for the integration of computer, communication, and consumer electronics technology.

Taiwan's cable TV environment, though it provides broadband service to 75% of Taiwan's households, has no backbone network, and no switching, transfer, or other functions between headends. The telephone network, in contrast, has a backbone network supporting switch, transmission, and other functions between switches, although this service is mostly narrow band. Integrating cable TV and telephony will take significant technical innovation, massive capital investment, and visionary regulatory policies.

This scenario is familiar in countries throughout the world with the building of National Information Infrastructures (NII). And these NIIs will eventually merge to form a Global Information Infrastructure (GII) based on the guiding principles for building the GII adopted in 1994 by the International Telecommunication Union, affirmed in the 1995 G7 Telecommunications Ministerial and at a major 1996 Asia Pacific Economic Cooperation meeting. Although this paper focusses on cable TV/telephony convergence as part of Taiwan's NII efforts, it is just one piece of the puzzle which will connect, and perhaps unite, the world through communications.

3. TAIWAN'S CABLE TV AND TELECOMMUNICATIONS ENVIRONMENTS

3.1. CABLE TV ENVIRONMENT

3.1.1. Cable TV Law --- Taiwan's cable TV industry is one of the most developed in the region, with one of the highest penetration rates in the world, 75%, and programming comprised of about 50 locally-produced programmers and 15 foreign-based satellite transmitted channels, with monthly subscription fees of USD 15-20. At the time it was finally legalized in November, 1993, cable TV in Taiwan had grown from one small cable station in 1969 to an industry with annual revenues of USD 600 million earned from 2.5 million subscriber households being served by 300 cable operators.

Under the Cable TV Law (Cable Law), all of the "illegal" cable TV operators were given amnesty if, by the end of 1993, they registered with the Government Information Office (GIO), the organ which regulates cable TV. Even though only about half of the 618 companies registered were actually cable TV operators, all of those which registered were eligible to apply for a cable operator's license. To apply, companies had to provide sophisticated operating and business plans, pledge significant paid-in capital, and meet technical specifications which would require retrofitting or completely rebuilding the cable TV networks.

The Cable Law divides Taiwan into 51 Cable Districts and allows 5 cable operators in each District. The reason for *five* districts was a compromise to accommodate competition among the political party-backed operators and some of the conglomerates looking to enter the market. Also, the Cable Law limits any one Taiwan investor to a 20 percent share of a cable operator, investment in only one operator per District, and puts limits on trans-district ownership. The Cable Law also restricts foreigners to less than 20 percent investment in a Taiwan company which has holdings in cable operators, in effect limiting foreigners to a maximum of just under 4 percent investment in any single cable operation.

Though the Cable Law allows for a maximum of 255 operators, the market can only support one to two operators in most Districts. Even before licenses were awarded, a number of the 204 companies which submitted license proposals by the March, 1995 deadline merged or were bought out. Awarding the 120 preliminary licenses has not stopped the mergers and buyouts. In Taipei for example, the five licensed operators in each of Taipei's five districts have already merged into two operators in each district. Market forces are expected to result in having only one operator in most of Taiwan's cable TV districts by the end of 1998. This will increase the need for a strong GIO to regulate the local monopoly cable operators.

The Cable TV Law, though it was successful in legalizing and giving some order to the cable TV industry in Taiwan, 1) does not give GIO sufficient power to effectively regulate the evolving market, and 2) is the main *legal* obstacle to convergence (see REGULATORY ISSUES below).

3.1.2. Status of the Networks --- The Cable Law requires newly-licensed operators to complete a new, or retrofit existing, systems within three years (by 1999) of being awarded a preliminary license, after which MOTC will award a license valid for nine years. Many of the operators 1) have been delayed by bureaucratic obstacles to underground cable installation, 2) are watching to see which multimedia and cable/telephony technologies will become standards, 3) are waiting for the optimum merger offer, or a combination of the three.

However, GIO reports that some 45 cable operators are already moving from straight coaxial cable to hybrid fiber/coaxial (HFC) and about 35 cable operators have adopted encoded addressing systems, which pave the way for interactive cable services. Of course installing fiber to the last amplifier (FTTLA), fiber to the node (FTTN), and fiber to the curb (FTTC) are still ideas which will have to wait for economic feasibility.

3.1.3. Major Operators --- Despite the 100+ operators throughout the island, it is the 1) sizable necessary investment, 2) market forces, and 3) companies and GIO alike conveniently turning a blind eye to the regulations, which will lead Taiwan's market eventually to be dominated by a handful of major companies. The local cable operators, mostly small enterprises, realize they are not big enough to compete with telecom service providers. That would require significant resources to reach competitive economies of scale for both network building/upgrading and operating.

Among the many players, however, two Taiwan conglomerates are positioning themselves to play major roles in cable TV: Rebar and United Communications. Rebar is a widely diversified company, whose holdings include construction materials, real estate, and media. In 1996, Rebar established three new channels with an investment of USD 110 million, and proposes to invest another USD 300 million through 1999 to develop other channels.

Rebar also holds minority interest in 20 cable operators, with 1.2 million subscribers throughout Taiwan and over 70% market share in Taipei. In July 1997, Rebar invested USD 70 million to build an island-wide HFC network to be completed within three years. In September Rebar invested USD 12 million with four Taipei affiliate cable operators to set up a local MSO, which the partners plan to expand in the long term into an island-wide MSO requiring an estimated investment of USD 1.3 billion. Rebar also intends to launch direct broadcast satellite (DBS) service by May 1998. In addition, in cooperation with United Fiber Optic Co. and Hitron Technology, Rebar is working on a broadband interactive service trial program which is scheduled to run through 1999.

Another major Taiwan cable TV company, United Communications (Ho Hsin, or UC), is a subsidiary of the Koo Group, a broadly diversified company involved in banking, insurance, hotels, petrochemicals, advertising, and communications. With significant ownership shares of 25 cable operators accounting for 2 million subscribers, UC invested USD 260 million in cable TV programming and upgrading its cable systems. UC is a major program provider, developing its own programming as well as representing 10 major foreign and Taiwan programmers, including MTV, Discovery, TNT, and CNN.

A UC affiliate recently became a major player in Taiwan's telecommunications service industry, winning a mobile telephone license for Taiwan's lucrative northern region. UC looks to leverage this by integrating cable TV, satellite, and telecommunications services into an island-wide network. UC's progress on HFC network construction is the fastest among all cable operators in Taiwan, with already 3,000 kilometers of HFC cable networking which will be augmented by another USD 160 million in island-wide network construction. UC is also moving forward with convergence projects. In September 1997, UC paid USD 14 million for controlling shares in Bao-Fu Cable TV, which is the operator involved in Taiwan's foremost cable and telephony integrating pilot project (see 4.1.4. Broadband Experimental Networks below). UC also plans an advanced cable/telephony broadband interactive services trial program in Taipei. In addition one UC affiliate provides satellite up-link services while another has signed a memorandum of understanding with Hughes Network Systems, Chunghwa Telecom Co., and Microelectronics Technology to work together on Internet satellite transmission services.

3.2. TELECOMMUNICATIONS ENVIRONMENT

3.2.1. New Telecom Law --- Taiwan's new telecommunications legislation (Telecom Law), promulgated in February, 1996, opened the way to telecom liberalization. The monopoly operator/regulator, the Directorate General of Telecommunications (DGT), was stripped of its operations responsibility, left to perform the regulatory function. Operations were shifted to a newly-formed state-run company, Chunghwa Telecom Co. Chunghwa is responsible for constructing and installing telecommunications equipment and providing basic network and value-added services, which accounted for revenues exceeding USD 5.9 billion in fiscal year 1997.

The Telecom Law also divides services into Type One and Type Two. Type One is basic telephone service including wireless services, and Type Two (also called value-added network services, or VANS) are those services using the Type One network and adding value such as voice mail, fax store and forward, and various other data services.

The Telecom Law also allows for 20% foreign investment in private providers of the Type One services which are determined by the Ministry of Transportation and Communications (MOTC). Value-added network service providers are allowed up to 100% foreign investment. It is worth noting that nowhere in the Telecom Law is any mention of convergence (see 4.2. REGULATORY ISSUES below).

3.2.2. Telecom Network --- Chunghwa's basic network consists of over 10.4 million local subscribers -- over 48 lines per 100 population -- ranking Taiwan among the top 25 in the world. The 13.2 million locally switched telephone lines are over 98% digitally switched, while the 960,000 long distance lines are 100% digitally switched. Chunghwa plans to have 100% optical fiber for all 1) long-distance wired trunks by the end of this year, 2) international submarine circuits by 1999, and 3) interoffice trunks by 2000. ISDN service, first offered commercially in 1995, now has 4,712 subscribers.

Taiwan has committed to start privatizing Chunghwa by 1999, and liberalize both mobile and fixed network satellite communication services by 1999 and to liberalize basic wireline service by 2001. Meanwhile, Chunghwa's cellular telephone network -- 700,000 American Mobile Telephone Service (AMPS) analog subscribers and 500,000 Global System for Mobile Communications (GSM) digital subscribers -- has been facing competition since the late-1997. In mid-January 1997, three GSM licenses, one for each region (northern, central, and southern), three regional Personal Communication Service (PCS -- 1.7/1.8 Gigahertz) licenses, and two island-wide PCS licenses were awarded to six foreign-invested consortia. The market is expected to reach 6 million subscribers, over 25% penetration rate, by 2000.

In addition Chunghwa's paging network of 2.4 million subscribers will is also facing competition. In late-January 1997, two island-wide and six regional paging licenses for service on 284.5 to 285.5 megahertz were awarded and service started toward the end of the year. The paging market is expected to reach 5 million subscribers by 2002. The two other Type One wireless services which were liberalized in 1997 were trunking radio (eight licenses were awarded in March 1997) and mobile data communications (20 licenses were awarded in April 1997).

3.2.3. Type Two Services --- In contrast to the previous regulations which contained a "positive list" of allowed VANS services, the new regulations use a "negative list", allowing companies to provide VANS not specifically prohibited. There has also recently been a major step toward liberalizing digital high-speed broadband technologies: the authorities have categorized as Type Two those data services which use ATM or frame relay switching equipment not integrated with the existing public network. However, voice transmission over private networks, including Internet phone, is prohibited.

3.2.4. Satellite Services --- As of October 1993, private firms were permitted to lease transponders from Taiwan's monopoly telecommunications services provider, to establish networks for satellite communication or broadcast television services. As of December 1994, foreign and local satellite organizations could lease or sell transponders to broadcasters to establish satellite base stations and relay program signals for their own use. Starting in April 1996, VANS providers were permitted to establish very small aperture terminal (VSAT) networks for domestic data communication service. Starting in August 1997, commercial satellite up/down-link services were allowed. Direct broadcast satellite (DBS) service is currently unavailable in Taiwan. Coinciding with Taiwan's telecommunications and broadcasting privatization plan which will allow private competition in satellite communication services, DBS service is expected to be launched between 1998 and 1999.

4. INTEGRATING THE NETWORKS

Efforts to integrate cable TV and telephony are under way. Taiwan's National Information Infrastructure program, including a number of pilot projects to develop domestic broadband two-way communications and media capabilities, is an important part of these efforts. Convergence in Taiwan faces not only technical challenges, but also regulatory obstacles.

4.1. NATIONAL INFORMATION INFRASTRUCTURE

To help ensure that Taiwan will play a major role in global communications in the next century, the Taiwan authorities are developing a National Information Infrastructure (NII). The Taiwan authorities estimate that from 1995 through the year 2005, USD 10 billion in public and private funding will have been invested in NII development. From 1997 through 1999, planned public funding appropriations will exceed USD 600 million for network development, technology R&D, applications, and other related infrastructure improvement.

Taiwan will use NII as an engine to keep its information technology hardware industry moving forward despite significant migration of its manufacturing to lower cost offshore venues in the region. The NII will also spark domestic software development, helping to build an information infrastructure which will not only support Taiwan's economic growth but also help Taiwan realize its goal of being an Asia-Pacific Regional Operations Center (APROC) for telecommunications, financial services, transportation, manufacturing, and media services.

The broad guidelines for the NII laid out in 1994 by Taiwan's premier include increasing the use of data communication services, developing a domestic multimedia industry, propagating the NII and educating end-users, integrating networks, and ensuring conformance with international standards. Another essential aspect is implementing and expanding broadband experimental networks.

4.1.1. NII Task Force --- A high level Task Force headed by a cabinet-level minister was established to oversee the NII project. Other Task Force members are officials and other key decision makers from the relevant ministries, think-tanks and research institutes. Aside from working groups for resource planning, network construction, application technology &

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promotion, human resources education, and public services, there is also a Private Sector Advisory Council made up of Taiwan information industry, academic, and related association leaders. Legislators have also formed a separate oversight group to monitor and maintain close communication with the NII Task Force.

In addition, the Taiwan Electric and Electronic Manufacturers Association (Taiwan's largest scientific technology industry association) and Industrial Technology Research Institute's (ITRI) Computer and Communications Research Laboratory (CCRL) co-organized an NII Committee to focus on Internet, set-top box, broadband services, and network development, as well as on overall policy & regulations.

4.1.2. NII's Five Goals --- Significant progress in NII development has been made in the past two-half years, including the completion of an island-wide high-speed broadband experimental network and international high-speed broadband connections with Hong Kong and Singapore. Experimental projects on distance learning, telemedicine, VOD, and electronic library were launched. Progress on the Internet has been remarkable: commercial subscribers have increased from 4,300 in 1995 to 350,000 at the end of 1996, as the bandwidth of network connection with the U.S. has also expanded from 512 Kbps in mid-1995 to 12,816 Mbps at the end of 1996.

The authorities have set five goals for NII development:

- promote the use of the Internet, hoping to have 3 million Internet users by 2000;
- promote Internet in the schools: to have all senior high and senior vocational schools on-line within 3 years, all junior middle schools and primary schools on-line within 5 years, and to have a minimum of one networking-multimedia computer per 20 students;
- establish Taiwan as an Asia-Pacific Internet hub by liberalizing communication services within Taiwan and expediting network connection to all countries in the region;
- establish a "Global Chinese Network Information Center" to the one fifth of the world's population which speaks Chinese;
- develop Taiwan's multimedia networking industry as a logical progression from Taiwan's role as a the world's third largest manufacturer of information technology hardware.

4.1.3. Network Integration --- Merging broadband cable TV and telecommunications networks is a key to NII planning and one of the three essential elements to network integration, along with popularizing the Internet and building an island-wide broadband optical high speed fiber backbone.

4.1.3.1. Cable TV is an important building block in Taiwan's NII. And because of Taiwan's extensive cable TV development Taiwan has a perceived advantage in the region for linking consumers to the NII through the cable TV networks. Most operators will eventually build networks with 550 to 750 MHZ (able to carry some 60 channels). However the networks need to be upgraded. And due to cost considerations in this competitive market, many operators are still reluctant to bear the extra expense for digital-ready networks capable of supporting interactive communication. But networks must be built/upgraded if the cable TV system is to play the major role envisioned by NII planners.

4.1.3.2. A second essential element of network integration, and an integral part of the NII plan, is popularizing the use of the Internet. Future Internet growth is indicated by the Taiwan Executive Yuan's goal to expand the present 1.2 million users to 3 million by the year 2000, and the authorities' plan to spend US$ 600 million over the next three years on Internet-related infrastructure improvements.

The academic network, called TANet, has 500,000 users; the Chunghwa-run HiNet has 300,000; with 100,000 on SeedNet, a service the Institute for Information Industries (III) provides. Chunghwa's HiNet and III's SeedNet provide international network connection service to over 70 Internet Service Providers through ten dedicated T1 (1.544 Mbps), one T2 (6 Mbps), and two T3 (45 Mbps) lines. Nearly 2,000 Taiwan based companies already having homepages on the World Wide Web.

Despite healthy growth of Internet use, obstacles to even more significant growth have been Taiwan residents' limited use of computers for on-line services, and the lack of availability of Chinese-language information and Internet application software.

4.1.3.3. The third essential element of network integration is an island-wide broadband optical high speed fiber backbone. Taiwan's toll circuits (long-distance wireline transmission networks) are now 100% optical fiber, and 100% of interoffice trunks will be by 2000. With ATM-switching devices and the island-wide fiber layout, the backbone allows data transmission speeds to increase from 64K-1.544 Mbps to 45-155 Mbps. Taiwan plans to have 100% of subscriber local loops to be optical fiber by the year 2020.

4.1.4. Broadband Experimental Networks --- The NII spawned two original broadband multimedia pilot projects, one in Hsinchu Science-based Industrial Park (HSIP) and one in Taipei. In July and November, 1995, the networks in Hsinchu and Taipei, respectively, were completed.

4.1.4.1. The Hsinchu project resulted in Taiwan engineers developing the ATM switches which interconnect Chunghwa's three regional operation headquarters, Chunghwa's Telecommunication Laboratories (TL), the National High-Speed Computing Center, the HSIP Administrative Bureau, National Chiao Tung University, National Tsing Hua University, and the Industrial Technology Research Institute's (ITRI) Computer and Communications Research Laboratory (CCRL). Over one hundred firms located in HSIP are also linked with the broadband experimental network.

4.1.4.2. The Taipei pilot project includes distance health care, library, and learning services; weather broadcasts; and near video-on-demand, multimedia data bases and cable TV service, coordinated by the Institute for Information Industry (III) and private companies in the Nankang Software Park. The Taiwan University, Tsinghua University, Chiaotung University, and National High-speed Computing Center distance learning systems are also interconnected on this broadband network. In a related development distance medical diagnosis systems (DMDS) were established between Chengkung University Hospital and the Penghu Hospital (on an offshore island), and between Veteran's Hospital and Kinmen Hwa-gang Hospital (also on an offshore island).

The three following programs are more closely related to convergence.

4.1.4.3. Chunghwa's Northern Region Business Group led the installation and testing, and Telecommunications Laboratory's Applied Research Laboratory provided technical support and system integration service for the development, construction, and operation of a "Telecommunications, Video, Interactive Multimedia Service" pilot system. In the project's first stage, started in March and completed in December, 1997, Asymmetrical Digital Subscriber Line (ADSL) transmission technology was used in a system which provides plain old telephone service (POTS), live video, and Internet service to twenty-eight subscribers in Taipei's Chung-chen District.

The workstation construction includes a Video Service Engine, Live TV Server, Internet Access Server, Network Manager, User Gateway, Video Switch, and ATU-C (Asynchronous Digital Subscriber Line Terminal Unit-Central Office End). Subscriber equipment developed for the program are set-top box, ATU-R (Asynchronous Digital Subscriber Line Terminal Unit-Remote End), and multimedia remote control devices. Multimedia information is transmitted from the services center work station, through regional switches and the ADSL, to subscriber's TV sets, each equipped with a Set Top Box.

The project's first phase verified that ADSL would support interactive multimedia service. The second stage, starting in June 1998, will test system integration compatibility to 200-400 subscribers, paving the way for larger scale construction by early 1999. The key technologies and equipment were developed by Chunghwa's TL.

4.1.4.4. In October, 1995 Taiwan's premier tasked the Ministry of Transportation and Communications (MOTC), the Government Information Office (GIO), and the NII Task Force to study cable TV/telephony developments abroad and draft a plan for convergence in Taiwan. MOTC organized an international symposium in February, 1996, a symposium for domestic enterprises in April, and a symposium for relevant Taiwan authority organs in June. Shortly thereafter GIO was tasked with eliminating regulatory restrictions for convergence (see 4.2. REGULATORY ISSUES below).

DGT's Radio & TV Broadcast Technology Department is overseeing a "Pilot Project for

Integrating Cable TV and Telecommunications". DGT is subsidizing equipment and network connection fees, and Chunghwa's TL is providing the cable TV and telephone network connection technology. ITRI's CCRL focuses efforts on developing the cable modem (see 5. TAIWAN AS CONVERGENCE HARDWARE MANUFACTURER below) while academic experts provide necessary inspection and consulting services.

The trial areas are in the Hsinchu Science-based Industrial Park and Taipei, using the cable TV networks of two local cable TV operators, Chu-Shih in Hsinchu and Taipei Bao-Fu. One hundred subscribers in each of the two cable networks participate in the trial. The planning was finished at the end of 1996, and the test will run from April, 1997 through March, 1998. The pilot networks provide subscribers fast access to the Internet through an Internet router, and cable TV networks connect (through 3Com and Westend cable modems) with telecom networks for two-way operation.

4.1.4.5. In still another pilot project, the NII's Private Sector Advisory Council has pioneered a video-on demand project. The system planning has been completed and specifications finalized for set-top box design, with the prototype constructed in June, 1996. Chunghwa has completed this program's phase one HFC network, which has six fiber nodes and 1,548 home-passes. This trial program provides near-video-on-demand, high-speed data transfer, Internet access, and telephony over HFC. Trial runs for two hundred subscribers began in March 1997.

Major hardware and software providers involved in this pilot program are Celerity for video server, INC for VDT gateway headend equipment, Tatung for set-top box, and IBM for system integration.

4.2. REGULATORY ISSUES

As mentioned above, in October, 1995 Taiwan's premier announced an initiative to merge cable TV and telephony. This included eliminating legal and regulatory obstacles. Taiwan's new Telecom Law does not prohibit telecommunications service providers from operating cable TV.

The Cable TV Law, however, is the major legal obstacle preventing convergence. Article 22 of the law denies any applicant for cable TV operation if that applicant is involved in providing telecommunications service in Taiwan. Note that each of the above-mentioned broadband experimental trial programs require special permission because Internet and voice are still not permitted in cable TV service. GIO, though, does advocate amending the Cable TV Law to coordinate with liberalization of wireline basic telecommunications services by the year 2001. Industry experts expect the legislation to pass by the end of 1998.

However, an indication of opposition to convergence on the part of cable operators is reflected in their responses at informational meetings held in Taiwan's four major urban areas to discuss convergence with cable TV operators. A public official involved in the meetings said that the cable operators, which are mostly small companies, lack extensive cable TV industry knowledge and long term vision. Not surprisingly, he said, the cable operators were mainly interested in protecting their cable markets by keeping out the deep-pocketed telecommunications providers, and few cable operators had viable plans for longer than three years into the future.

According to press reports, a GIO official supported the cable operators' view. This official said that cross-media operation is not necessarily in the interests of the cable TV operators, who should first be allowed to operate across districts, giving them time to achieve critical mass sufficient to effectively compete with telecommunications service providers. Representatives not only from the small cable TV operators, but also from the major players, concur.

GIO and DGT officials, as well as private sector representatives, agree that just amending the Cable TV Law would not be sufficient to solve the wide ranging issues needing resolution between the two regulators, GIO and DGT. Taiwan will need a new communications and broadcast law to integrate the services. Considering how long it took for the legislature to pass both the Cable TV Law and Telecom Law, it may be a long time before Taiwan has an effective integrated set of convergence regulations, not to mention an integrated regulatory body. As a local expert on cable TV and telephony said, input from international media and telecommunications groups will have some impact on legislation and regulations, but more influential will be the high number of legislators whose families are intimately involved with media or media-related enterprises.

5. TAIWAN AS CONVERGENCE HARDWARE MANUFACTURERS

A modem is a data signal shifter, or translator. The word modem is a combination of the words "modulation" and "demodulation," the technical terms for signal transformation which has been mainly used for computers connecting over telephone lines. Much of the technical success of convergence will rely on more complex cable modems to facilitate voice service over the cable TV network, and ADSL modems to facilitate visual service over the telephony network. The fact that Taiwan is number three in the world in information industry hardware products (over USD 30 billion produced in 1997) and leads the world in computer modem production (over 16 million units in 1997, focused on 33.6 Kbps and 56 Kbps speeds), puts Taiwan in a strong strategic position to play a major role in cable and ADSL modems development and production.

ITRI's CCL has led cable and ADSL modems research in Taiwan. In late 1997, U.S. firm AMATI authorized CCL to establish technology transfer agreements with 13 Taiwan firms (including GVC, Hitron Technology, TaiNet, and United Fiber Optic) for a project to develop ADSL modems and related devices. This two year project, for which the Taiwan authorities have appropriated USD 40 million, is based on American National Standard Institute's (ANSI) discrete multi-tone (DMT) signal modulation technology. The ADSL modem prototype and related system should be ready by March 1998, system function tests such as temperature and electromagnetic interference will be completed in September 1998, with integration of the ADSL system into the ATM network in September 1999.

Other local firms are also getting involved in research and production. CIS Technology has formed an alliance with Turbo Net of the U.S. and Toshiba of Japan to develop cable modems, with first delivery expected by the first quarter of 1998. E-Tech has invested USD 3.15 million since late 1996 to develop cable modems which it predicts will hit the market in 1998. GVC Corporation, Taiwan's largest, and the world's second largest (behind U.S. Robotics), modem manufacture, is developing a digital simultaneous voice over data (DSVD) modem, expecting significant demand for cable modems to come as late as 1999. Other companies such as Zyxel and 3J Tech probably will also be important players in future cable modem production.

6. CONCLUSION

Taiwan is in a unique position as it approaches cable TV/telephony convergence. The percentage of households subscribing to cable TV is among the highest in the world, and recent telecommunications liberalization will position Taiwan to catch up with the telecom networks and services in most advanced countries. And though Taiwan's cable TV environment's lack of integrated, modern networks and its dispersed ownership has offset advantages of high user penetration, operator cooperation and consolidation is already starting to address these shortfalls. However, the present and potential problems from two separate regulatory agencies overseeing telecom and cable TV, respectively, still pose major challenges.

It will take strong and visionary leadership from Taiwan policy makers, as well as continued liberalization of the economy, especially the communications industry, to help Taiwan realize its NII goals, which include convergence. At the same time, Taiwan stands to gain significantly if it can become a world leader in convergence-related hardware manufacturing the way it has for other information technology products.

Regional and Industry Development Through the Convergence of Electricity and Telecommunications Industries

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1. ABSTRACT

Deregulation of the electricity and telecommunications markets in Australia is creating new opportunities and challenges for both industries. Optus Communications and ACTEW Corporation are developing a strategic relationship based on ACTEW's plans to build an advanced broadband communications network in Canberra, the nation's capital. Such a network will have a positive impact on regional and industry development.

2. INTRODUCTION

Much of the convergence debate over the past decade or so has focused on the convergence of technologies; i.e. between computing and telecommunications. A far more significant convergence is occurring, however, as a result of the globalisation of business, increased competition and the new applications enabled through technological advances. This is the convergence of once separate industries; e.g. insurance and banking, media and telecommunications and more recently, the telecommunications and electricity industries.

It should come as no surprise to anyone that electricity utilities are expressing a great deal of interest in telecommunications. This interest is relevant from two main perspectives.

Firstly, the telecommunications industry in Australia and elsewhere has already undergone a change from a monopoly environment, through a period of limited competition to full and open competition. This in itself provides some useful lessons for what is happening and is likely to happen in the electricity supply industry. In Australia, following the 1994 Hilmer Report into competition policy, the electricity market is being progressively opened to competition. Telstra, previously the monopoly telecommunications carrier in Australia, has itself applied for an electricity supply license.

Secondly, and seemingly of more interest, is the opportunity presented by the synergistic nature of the business. The global telecommunications market is estimated to be worth many billions of dollars, including internet and video services.

This is an attractive business opportunity for an industry looking to expand its interests.

3. ELECTRICITY UTILITY PERSPECTIVE

With increasing competition, electricity is being viewed more and more as a commodity. The incumbents are faced with a loss of market share and falling prices. They therefore need to make some difficult choices. One would be to increase growth in the existing market. This would be limited by the usage patterns of the customer base and would require substantial increases in advertising and promotional activities. Another is to expand the market by moving into new areas (competitor's markets) or acquiring competitor's businesses. A third is to diversify into new business streams. Which could also incorporate the first two options.

Many utilities are seeking to become multi-utilities offering a one-stop shop for a variety of products and services, including telecommunications.

The synergies between electricity and telecommunications include:

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- same customer base;
- similar customer service systems; e.g. call centres, billing systems;
- infrastructure;
- similar operational processes;
- benefits to both industries.

ACTEW Corporation is a relatively small utility with an annual turnover of A$340 million and an operating profit of A$46 million. It is fairly unique in that it is already a multi-utility. ACT Electricity and ACT Water were merged in 1988 resulting in the delivery of water, sewerage and electricity services within the one organisation. The infrastructure to deliver these services are viewed by ACTEW as networks which they own, maintain and operate. For some time, ACTEW has been considering the addition of a fourth network and is now well downstream on the planning for an advanced broadband communictions network for the city of Canberra.

At a later stage, gas may be added as a fifth "network".

4. TELECOMMUNICATIONS COMPANY PERSPECTIVE

As of 1 July 1997, the telecommunications market in Australia was liberalised to allow full and open competition, not just in services, but in network infrastructure too. As Australia's second carrier, one of the greatest challenges faced by Optus is the cost of providing a competing access network. To date, Optus has spent over A$5 billion on a trunk network and corporate CAN. A further A$3 billion, approximately, has been spent through Optus Vision on providing a local telephony and pay-TV network in major capitals, which is yet to provide an adequate return on investment.

Optus already has multi-faceted relationships with electricity utilities, including rights of way agreements, and is keen to work with them to develop a new model for the extension of network-based competition in Australia

5. THE TRANSACT PROJECT

ACTEW Corporation is 100% owned by the ACT Government and as such needs to meet some major objectives in the development of a broadband network. The first, of course, is that the business must stand alone and be commercially viable. Second, the network must be an open access network to stimulate service provider competition and third, it should contribute to the competitiveness and development of the Canberra region.

While, traditionally, monopoly providers have not taken much cognisance or market needs, ACTEW has been very proactive in finding out what its market wants.

ACTEW initially conducted a market survey of 300 households and businesses to determine whether there was sufficient interest to proceed and to understand what information was required for further investigation. This was followed up by an expanded and more detailed market survey, jointly funded by Optus, of 1000 households and 300 businesses.

The results were better than expected. Not only was there a much higher than average response rate, but the interview sessions were twice as long as the allocated time, due to the strong interest in the topic by the recipients.

The surveys were supplemented by ongoing focus groups, public meetings and speaking engagements to industry bodies within the industry and community.

The major outcomes were that the community of Canberra:

- definitely want broadband services;
- do not want to pay the additional cost of underground cabling, except where all other services are underground;
- definitely do not want multiple infrastructure providers delivering services which can be provided over one network; and

- strongly support a locally owned network; and
- do not necessarily want one supplier providing all services.

The project has now moved past the feasibility study to prototype testing and ACTEW has signed MOU's with broadband Technologies (BBT) and SAT. The project team has selected Switched Digital Broadband, or fibre to the curb, technology. Integration of the new technology will be conducted in association with BBT and SAT in three locations: Canberra, Paris and North Carolina.

The network will be a unique, switched digital broadband model, contributing to Canberra's reputation as a high technology city. The network will be capable of delivering:

- Basic and advanced telephony;
- Television (re-transmission of free-to-air);
- Pay-TV;
- Near video-on-demand and video-on-demand; and
- Interactive services, such as Internet, home shopping, home banking and distance education.

The next stage will be a pilot system, commencing around March 1998, where two suburbs will be wired up and a range of services will be tested. Once the pilot has been fully tested, the project will proceed to full network roll-out with a view to completion by the end of 1999.

6. THE BENEFITS AND ESSENTIAL INGREDIENTS OF A SUCCESSFUL STRATEGIC RELATIONSHIP

Deregulation and globalisation have created an environment that is characterised by a rapid pace of change and uncertain futures. The creation of profitable and mutually beneficial alliances minimises risk and maximises the commercial returns for the combined business.

When Optus and ACTEW first began discussions on a strategic partnership the model under scrutiny was that of a joint venture with injected capital from both organisations. At the time, ACTEW was not comfortable with an independent strategy where it took all of the risk of ownership and control. For its part, Optus was uncomfortable with investing in a new technology access network at a time when it was attempting to integrate its Pay-TV and local telephony business into its existing business. The hybrid fibre coax network which Optus deployed for Pay-TV and local telephony was still being bedded down and the diversion of capital to a new, untried technology platform could prove a high risk approach during the implementation of a strategy to maximise the use of existing assets.

In spite of these potentially conflicting strategies, ACTEW and Optus developed an excellent working relationship throughout the process and developed a joint vision, shared objectives and a win/win attitude based on mutual respect and trust. These are essential ingredients in the development of a successful relationship. The nature of this relationship could evolve into more of a partnership model at a later stage.

Also during the process, the increased understanding of the nature of the business, the outcomes of market surveys and growing confidence in the business case have led to a new look at the independent approach, where ACTEW will fund, build, own and operate the local network. This approach is highly consistent with the objective of encouraging multiple service providers to deliver services over the network. Optus will provide expertise and other support to ensure a profitable outcome.

Service providers maintain a direct relationship with their customers and ACTEW provides the access to those customers. This approach overcomes one of the major reasons for conflict in a number of ways to deliver the outcomes. This is explored in more detail in the next section. Optus is likely to participate in the pilot project and may invest in the project over time.

The benefits to ACTEW include:

- Experience of a new line of business which establishes ACTEW as a credible infrastructure build partner in other markets in Australia and the Asia Pacific;

- Additional revenue streams to protect against competition;

- Differentiation as a true multi-utility in a highly competitive market;

Optus benefits through:

- Access to an advanced broadband platform for delivery of advanced services;

- Opportunity to increase market share;

- Local access to an additional 120,000 customers;

- Opportunity to bundle services in new ways: and

- Scope to participate in advanced service development with other complementary industry players.

7. AGGREGATION OF COMPETITIVE ADVANTAGE MAKES BUSINESS SENSE

One of the mainstays of a successful business relationship is the blending of different but complementary skills and assets, where practical. ACTEW and Optus each bring considerable market strengths and experiences to the relationships.

ACTEW brings;

- Access to rights of way;

- Existing infrastructure such as power poles and cable ducts;

- A skilled workforce;

- Sound knowledge and experience in asset management;

- A 100% customer base with an associated long term relationship; and

- A strong brand image and track record.

Optus brings:

- Experience of building, managing and operating a sophisticated, advanced telecommunications network;

- Fibre and network infrastructure in Canberra;

- Knowledge and experience of wholesale operation;

- Experience in negotiating interconnection arrangements;

- Advanced network integration experience across fixed, mobile and satellite networks;

- An established customer base across government, corporate, business and residential markets; and

- A strong brand image and track record

Aggregation of the combined competitive advantages of ACTEW and Optus lays the foundation for a more profitable business and reduces both the implementation and societal costs of building a broadband network.

8. REGIONAL AND INDUSTRY DEVELOPMENT

As well as being the capital city of Australia and the seat of Federal Government, Canberra is a business hub for the Australia Capital Territory (ACT) and the region. Canberra itself has a population of approximately 300,000 but the wider region provides access to a population of some 5 million. The workforce of the ACT is generally well educated, highly skilled and lends intself to a high technical environment. There is a higher than average penetration of Pcs and Internet access, making it an ideal location for test-bedding advanced telecommunications and multi-media applications. There are already plans for a high speed rail link to Sydney and Canberra airport has recently been upgraded to international status. The addition of an advanced, broadband communications network will further stimulate job opportunities and additional business within the region.

Already, several local companies, including Internet service providers, have indicated an interest in participating in the development of a centre of excellence. One of the most interesting is a local video store chain interested in developing video on demand and near video on demand services. The marketing plan includes further stimulating the development of new applications and creating Canberra as a technologically advanced city, where businesses and investors will wish to play a part. For example, the development of applications for on line real estate and tourism transactions is a possibility. Other utilities in Australia are taking an active interest in the project, some with a view to utilise ACTEW's capabilities and others to investigate the applicability of the business model for their business. Optus is examining the options for appropriate business models for arrangements with other electricity suppliers.

ACTEW already has business interests in the Asia Pacific region, primarily in water purification projects. The development of a broadband communications network will give ACTEW and its strategic partners the opportunity to offer a total infrastructure build capability, i.e. water, sewerage, electricity, telecommunications and potentially gas, for developing areas and new developments.

9. SUMMARY

As in all environments of change, there are challenges and opportunities. While the challenges of building a new advanced broadband communications network are significant, the opportunities it creates will be exciting, rewarding and beneficial to all.

ACTEW, the network provider and Optus, along with other service providers have an opportunity to develop more profitable businesses.

The community of Canberra will be served by an advanced communications infrastructure providing access to high speed Internet, advanced video and multimedia applications and advanced telephony services.

Enhanced Information and Operator Services for Developing Countries and Newly Industrialized States

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1. ABSTRACT

In order for the telecommunication service providers of developing countries and newly industrialized states to economically enhance and expand their new and existing wireline and wireless telecommunications networks and services, non-traditional and innovative approaches are required. This is true for information and operator services which are provided to the public and business through the telecommunications service providers. Technologies and systems architectures are available today to allow for the implementation of such services on networks based upon past, present and future network topologies developed for wireless, wireline and satellite technologies.

2. INTRODUCTION

2.1 OVERVIEW

This paper covers the technology and architecture which is available to allow telecommunications service providers to implement standard and enhanced information and operator services through existing Commercial-Off-The-Shelf (COTS) hardware and software on past, present and future central office switching systems for wireline and wireless network topologies.

The concept of Enhanced Services-Switching Systems (ES^3) platforms for Enhanced Information and Operator Services; and call centers is introduced. The architecture and technology available to allow the telecommunications service providers including wireline, wireless and satellite based to offer leading edge value added information and operator services. The ES^3 architecture uses existing standard hardware and software and can accommodate all types of central office systems and manufacturers.

All major applications are covered including: Electronic Yellow Pages, Debit/Credit Card, Enhanced 911 Emergency, TRS (Telecommunications Relay System) for the hearing and speech impaired, Directory Assistance, Operator Assistance, Prison Call Management and others designed to meet the specific needs of telephone and telecom service companies. Examples of existing systems are described including those used in satellite based international gateway systems, island nations, independent U.S. telcos and in particular a system being implemented in Southeast Asia by a major carrier.

Detailed descriptions are given of the systems digital switch and network interface; the applications processor and the operator workstations.

The unique requirements for the implementation of operator/ information services of the developing countries are addressed including a number of suggested alternatives to meet those requirements, In addition, methods of implementation are reviewed including strategic relationships and technology transfer.

Suggestions as to how developing countries can economically implement operating and information services are made and conclu-

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sions drawn.

2.2 THE TELECOMMUNICATIONS ENVIRONMENT

The telecommunications environment of the late 1990's and the first 5 years of the millennium finds the traditional telecommunications carriers of developing countries and newly industrialized states repositioning themselves to adapt to new network, hardware and software platforms, and to new competition. These entities and their new competitors must address the following elements which make up the new environment:

- the deregulation and denationalization of the telecommunications networks, service providers and manufacturers which allows for the creation of competition and new business opportunities. The recent 1997 World Trade Organization agreement by seventy nations on telecommunication services is a prime example of this.

- the availability of new technologies, networks and information services which shorten the life cycle of systems and create new opportunities for those carriers that can optimize on these new offerings. This includes the new wireless and satellite technologies.

- the exponential growth in the outsourcing and systems integration business gives new opportunities to the telecommunications carriers allowing them to expand into new international and industry markets. This includes the provision of Call Center services such as those supplied by Cincinnati Bell's Matrix subsidiary in the U.S.

- the requirement to learn to manage the new technologies, systems and services as applied to meet the carriers customer's applications needs where operator services are no longer a cost center but are a profit center.

- the need to interconnect a variety of new and existing telecommunication networks, terminals and communication based information systems of different vintages, standards and manufacturers.

- the need to adapt existing systems to new platforms, from analog to digital, from wires to wireless, from centralized systems to distributed, from old computer languages to new, from terrestrial to satellites, and from main frame computers to servers, workstations and micros.

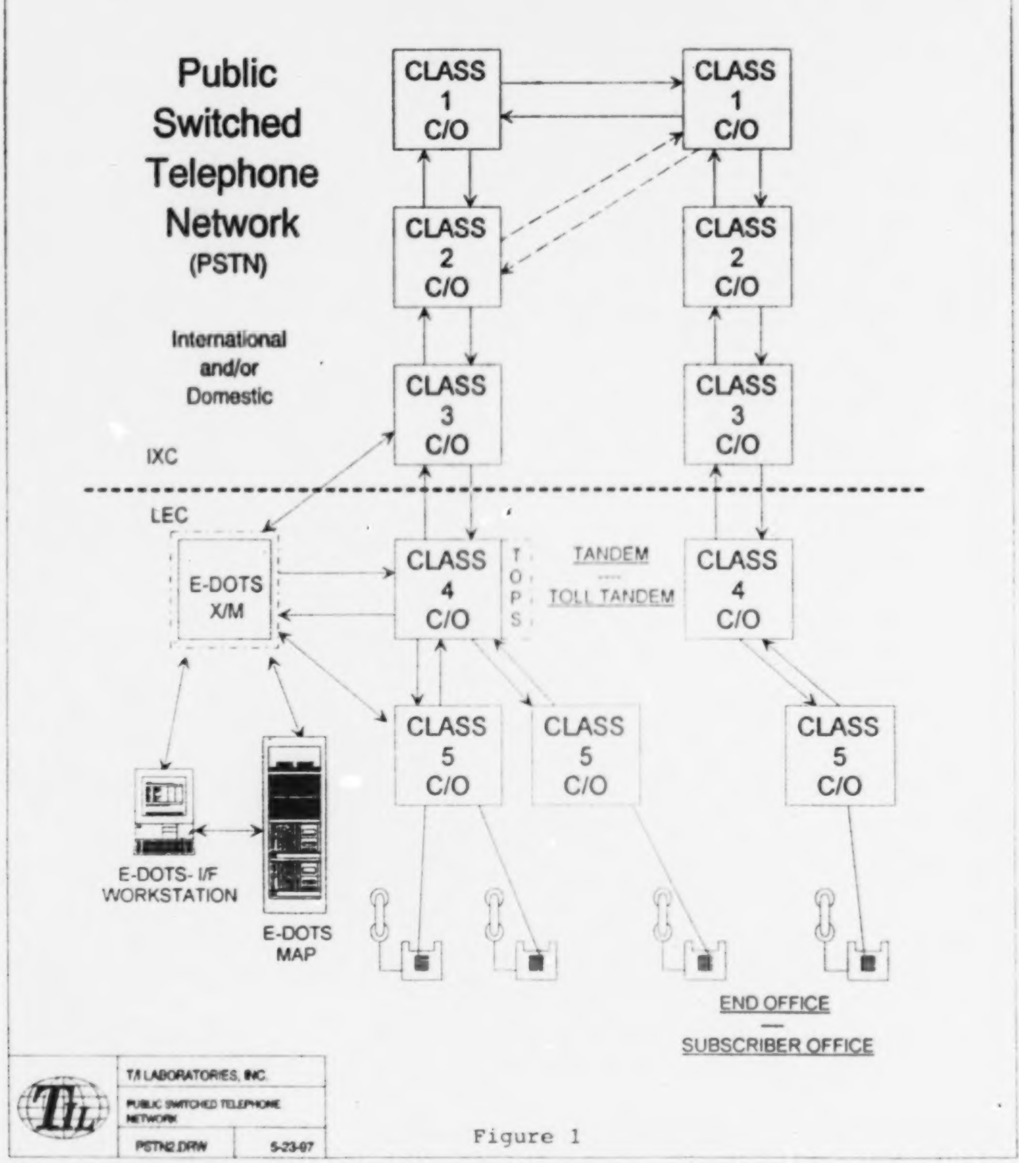
- the carriers have pressure to improve productivity and find new revenue sources such as competing for the fast growing international traffic, the creation of teleports for satellite based services, and the offering of value added services above plain old telephone (POTS) services.

3. TELECOMMUNICATION SERVICE PROVIDERS OVERALL REQUIREMENTS

Figure 1 shows the typical public switched telephone network topography with the various classes of central offices. It also shows the demarcation between long distance services or interexchange carriers (IXCs) and the local exchange carriers (LECs) services. This type of demarcation is new or does not exist in a number of countries. However, it is an indication of the new competitive environment which has existed for some time in the U.S. and is now being implemented in some form in many countries. With the new U.S. 1996 telecom bill the long distance carriers can become LECs and the LECs can become IXCs.

The enhanced operator and information services systems are normally added to the Class 4 Toll Tandem exchange of the local

How T/I Labs ES Systems Interface Telephone Networks


Public Switched Telephone Network (PSTN)
International and/or Domestic
IXC
LEC
CLASS 1 C/O
CLASS 1 C/O
CLASS 2 C/O
CLASS 2 C/O
CLASS 3 C/O
CLASS 3 C/O
E-DOTS X/M
CLASS 4 C/O
T O P S
TANDEM
TOLL TANDEM
CLASS 4 C/O
CLASS 5 C/O
CLASS 5 C/O
CLASS 5 C/O
E-DOTS- I/F WORKSTATION
E-DOTS MAP
END OFFICE
—
SUBSCRIBER OFFICE

T/I LABORATORIES, INC.
PUBLIC SWITCHED TELEPHONE NETWORK
PSTN2.DRW 5-23-97

Figure 1

telephone company as indicated in Figure 1 as the E-DOTS-X/M (Enhanced Digital Operator Traffic System) and its components. The long distance carriers and international carriers can add them to their gateways and to their central offices designated as information and operator service centers. The wireless and satellite carriers can add the ES^3 platform to the network control centers, toll exchanges and/or teleports (earth stations).

The general customer requirements, taken in the context of the customer being the telecommunications carrier and the supplier being the manufacturer of the enhanced information and operator services system, is shown in Figure 2. The system includes a transparent switch network interface, operator positions (workstations) and an applications processor which allows for the offering of data base and information services.

3.1 ES^3 SWITCHING SYSTEM AND NETWORK INTERFACE REQUIREMENTS

The switch network interface component of the ES^3 should be equal in availability to that of the standard digital public switched network toll exchange, It is required to be a fully redundant system for uninterrupted service. The switch is to be a fully digital tandem type of exchange with the ability to accommodate local exchange switching functions, be transparent to network protocols, interface multiple switches and distribute calls to operators and automated voice response systems.

In order to insure uninterrupted service the switching system is to be self diagnosing for in-service problem definition and allow for in-service maintenance to minimize down time.

The ability to concurrently support multiple toll exchanges is a key requirement in particular for those carriers that may be offering services to other interexchange and local exchange carriers or are centralizing. The switch must be capable of interfacing all types of central offices and networks including analog, digital, wireless, satellite systems and international gateways.

Queuing, prioritization and auto call distributions to operator workstations, public safety access points and automated systems are a major requirement.

The switch must be designed based upon a flexible architecture which would allow for growth and for the accommodation of new features and functions.

The switch software is to be transportable to switch platforms provided by other manufacturers.

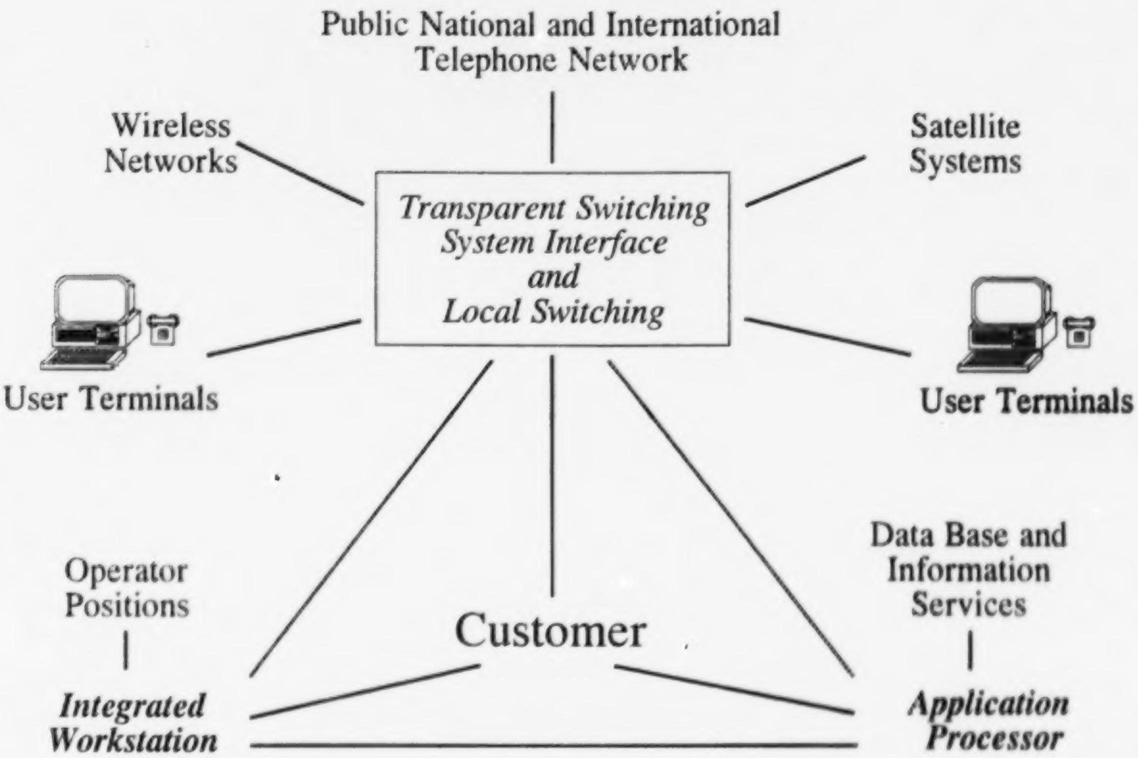
3.2 OPERATOR POSITION/WORKSTATION REQUIREMENTS

The operator position is key since it is the person machine/system interface and is the support unit for the operator interface to the telecommunications service provider or call center customer. The requirement is for an integrated intelligent workstation for the operator which is based upon standard PC or workstation products and standard operating systems such as DOS or Windows.

The position should be capable of integrating voice and data, have direct access to the switch and direct access to the application processors. This is to allow for quick responses to the service providers customers and to optimize on the operators work time.

Ergonomic design of the keyboard and display is of prime importance and is to include function keys, color-coded function groups and keyboards designed for specific applications. Special operator support features are also required which include digital voice announcements, digital voice recording and the capability to have one position handle multiple types of operator information and call center services. The system should have the capability to provide automated operator services using Interactive Voice Response

General Customer Requirements



Public National and International
Telephone Network

Wireless
Networks

Satellite
Systems

Transparent Switching
System Interface
and
Local Switching

User Terminals

User Terminals

Operator
Positions

Customer

Data Base and
Information
Services

Integrated
Workstation

Application
Processor

Figure 2

T/I LABORATORIES INC.

Systems.

3.3 APPLICATION PROCESSOR REQUIREMENTS

The application processor is to be a high speed real-time computer. It is to be based upon a standard commonly available server machine using a standard operating system and data base management system. It should be capable of local data base support and have the ability to access remote data bases and computers. Its local and remote data base access system has to have the capability to support billing and accounting functions.

The ability to provide the operator access to multiple applications is mandatory. These applications include standard applications like directory assistance, 911, and toll assist and special information services such as electronic yellow pages, well care, call center applications, hotel billing, systems for the hearing and speech impaired, and prison systems.

Reliability and redundancy is another requirement of the application processor. It should have the ability to operate in a hot stand-by mode in a duplexed configuration and should have the capability to have a duplicate and back-up database and file system.

4. DEVELOPING COUNTRIES AND NEWLY INDUSTRIALIZED STATES REQUIREMENTS

The implementation of traditional public telecommunications technologies will not allow the developing countries to reach the required telephone, data terminal, fax, video and integrated, fixed and mobil terminal population per capita necessary for development. New and innovative methods are required including new approaches to the regulatory and telecommunications industry infrastructure. In most cases, using the developed countries as a model is not appropriate for the development of telecommunications in the developing countries and newly industrialized states.

The most important issue for the telecommunications service providers of developing countries and newly industrialized states is to define the technologies they require to provide the necessary and enhanced services to the populace, businesses and institutions based on what is proven and available. In addition, the carriers must capitalize on existing installed equipment and optimize on the new technologies available such as wireless and satellite based networks.

4.1 BASIC NEEDS

The need is for a basic reliable universal service plus universal access to value added services, that provides a foundation for future growth and new services. This service needs to be available at a minimum to the public areas of every hamlet, town, village and city. Implementation is to be quick and easy.

Certain operator services, such as 911, directory assistance and toll call assistance, are essential. In addition, there is a need for emergency and disaster control systems. These systems are required to optimize on the country's languages and dialects. Also needed is the development of a method to simplify billing.

4.2 SPECIFIC REQUIREMENTS

The requirements for information and operator services of the developing countries and newly industrialized states telecom service providers are driven by country specific requirements which include the following:

- the enhanced information and operator service switching and interface system needs to interface with old analog exchanges and signaling systems in order to offer the operator services enhancements to such systems. The switch requires the capability to access a satellite earth station and to interface wireless based networks.

- the operator positions must have a national language keyboard and function keys designed for country specific applications. The displays on the screen are to be in the national language and in some cases multiple languages are required.
- the application processor and data base machine need to have its data base in the national language and format. In particular the names in the directories. Applications unique to the country can be added by the telecommunications service provider.
- the system should have local content. This could be in the form of technology transfer in regard to the building of the switch/interface and the development of the software. It can also include locally manufactured and/or assembled PCs as operator positions and locally available UNIX file servers as application processors.

5. APPLICATIONS

The enhanced information and operator services applications include:

- Directory Assistance
- Electronic Yellow pages
- Property Database
- Enhanced E911
- International Gateway
- Automatic Message Accounting
- Toll Assistance
- Prison Call Management
- Mobile/Marine Radio
- Automatic Rating
- Credit Card Calls
- Local Debit Cards
- Billing
- Booked Calls
- Intercept
- Well Care
- Message Center
- Hotel Billing Information Center
- Telecommunication Relay Service for the hearing and speech impaired

5.1 ENHANCED DIRECTORY ASSISTANCE

The Directory Assistance application provides a multiple search criteria to prompt the operator for the proper response to the inquiry. The search criteria is based upon name, address, city and other criteria. It also provides digital voice response. A new feature, call completion, allows for automatic dialing once the correct number is found.

Another type of directory assistance is the Electronic Yellow Pages which provides the carrier a database that can be accessed by product or service. As with directory assistance, the selected number can be automatically dialed forward.

5.2 PROPERTY DATA BASE

The Property Data Base application enables the telecommunications service provider to enter and maintain certain information about a property associated with a specific telephone number. This information is displayed on the operator's screen when a call comes in. For example, the application can enable the operator to provide customized greetings and determine what services are available for a particular property. In a similar fashion the Emergency Number Data Base application enables the carrier to enter and maintain the necessary emergency numbers associated with a particular property or phone.

5.3 CREDIT CARD VALIDATION

This application provides access to credit card data bases for card validation and authentication. It is capable of accessing most available external data bases via X.25, TCP-/IP or other protocols as required. The Credit Card Validation application provides for optional automatic call completion without operator assistance on validated credit cards.

5.4 ENHANCED 911 SERVICE

This application allows for two types of calls; emergency calls dialed with 911 and emergency calls dialed with O.

When a 911 call is received by the system it is directed to a dedicated terminal in the appropriate Public Safety Answering Point (PSAP), which is selected based on the ANI (Automatic Number Identification) of the calling party. A PSAP workstation has a unique display and the operator performs no other call handling functions except E911. All calls are recorded and archived.

5.5 OTHER APPLICATIONS

Each operator and information service application is a paper in itself and cannot be adequately described here. The purpose of this section is to make the reader aware of a myriad of such applications which are available and also, that there are systems in existence which enable the carriers to add their own unique applications.

The Telecommunications Relay Service application, for example, is for the speaking or hearing impaired to communicate with others via an operator by using a keyboard device. The operator (Communication Assistant) provides the appropriate text and speech conversions.

6. TECHNOLOGY TO MEET REQUIREMENTS

Figure 3 shows an Enhanced Services Switching System (ES^3) Platform Technology, known as the Enhanced Digital Operator Traffic System (E-DOTS) which meets the requirements as stated in the previous sections.

The digital programmable tandem switch and network interface (DOTS-X/M) appears as a tandem to the network and allows for the addition of the new services to the existing network and switches. It has the capability to interface a local Class 4 or 4/5, an international gateway, a satellite system through an earth station, wireless networks and private networks. It supports all carrier operator functions and can interface multiple switches simultaneously.

The switch is the first leg of a three legged architecture consisting of the switch, the operator positions and the application processor. All three legs are interconnected to allow for efficiency, reliability and speed.

The second leg is the operator position which is an integrated function workstation based upon a standard IBM compatible PC and MSDOS or windows called the DOTS-I/F (Integrated Function). It includes a specialized operator services keyboard and the ability to perform multiple functions from a single position including all applications described in this paper as well as multiple languages. The operator position communicates with the switch at 9600bps and with the applications processor over the enternet at

56kbps.

The applications processor, known as the DOTS-MAP (Multiple Application Processor), is the third leg and provides for all the data bases for all the applications both locally and remotely. It also interfaces a host computer for automatic billing and an Automatic Message accounting tape. It interfaces the switch at 9600bps and is the file server for the operator positions. The applications processor is a standard UNIX machine and is programmable by the telecommunications service provider.

The systems architecture as shown in Figure 3 allows for the networking of such systems, adding remote concentrators and expanding the size of the system to handle large numbers of operator positions and additional trunks. The architecture also allows for the addition of new and enhanced applications. Most important, due to the transparency of the switch, it can enhance old and new networks and central offices.

Figure 4 shows an expanded system which includes a remote switch/network interface, remote operator positions and an interactive voice response system. There is a total of 120 operator positions in this configuration. This system is installed in a major telecommunications service provider in Southeast Asia. The system provides directory assistance with call completion and call assistance to the country for domestic use only. It interfaces a Fujitsu switch (toll exchange) and an IBM RS6000 database for directory assistance. It has been customized to meet the unique requirements of the country's telephone company.

7. CONCLUSIONS AND RECOMMENDATIONS

The developing countries and newly industrialized states should consider all available resources and methods at their disposal in order to implement a telecommunications system which can provide basic reliable services with a foundation for future services. Railroads and utilities can assist in providing complementary infrastructures to the existing telephone networks. The national and international satellite systems can be used to develop alternate and complementary approaches. Cellular, PCN and LMDS technology can be used in lieu of stringing wire and burying copper. A new regulatory environment is required to allow for the optimization of resources.

The existing public national and international telecommunication networks can be enhanced with new information technology products. This will allow for new information and operator services as described in this paper including applications which are customer and country specific. Existing analog switches and new digital switches can be enhanced by attaching state of the art operator workstations based upon PCs, application processors based on UNIX LAN servers and small digital toll switches based on micro computers. These three components tied together into a systems architecture allow the carrier to provide a variety of new services without the need to replace existing switching systems, In addition, such architecture can enable the enhancement of local exchanges to provide custom calling features and usage sensitive pricing.

The carrier can then have the opportunity to provide the outsourcing of Call Center information and operator services to hotels, institutions and businesses through the implementation of enhanced information and operator systems. Such systems can apply to all types of services such as teleports, international gateways, wireless services and future internet and multimedia services.

As most are aware, it is not necessary for developing countries and newly industrialized states to evolve in telecommunications in the same manner as the developed countries. In fact, such an evolution can be a retarding force on the development of a country, By taking new approaches and implementing

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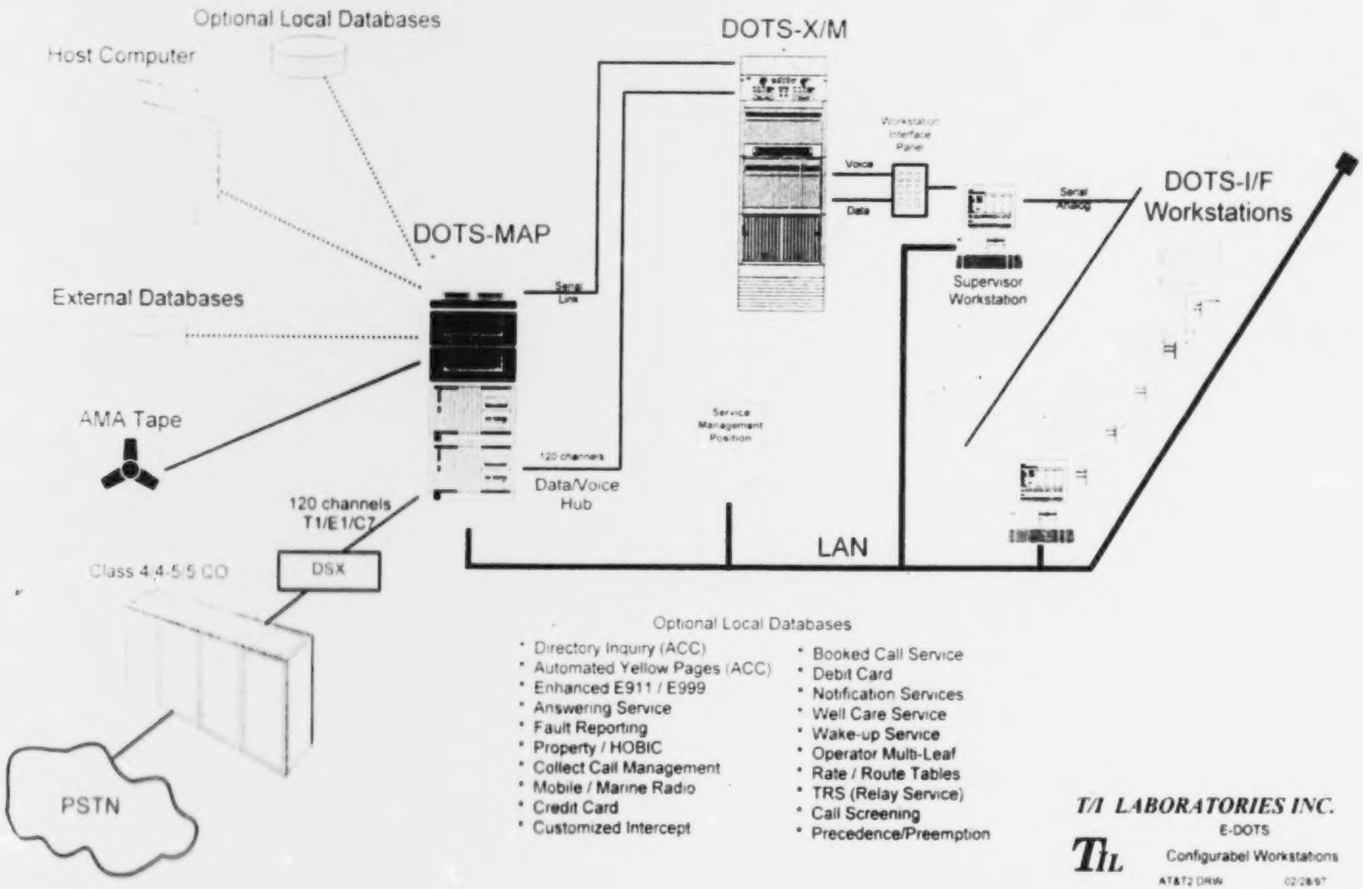
E-DOTS Enhanced Services Platform
Configurable Network CTI


Optional Local Databases
Host Computer
DOTS-X/M
Workstation Interface Panel
Voice
Data
Serial Analog
DOTS-I/F Workstations
DOTS-MAP
Serial Link
External Databases
Supervisor Workstation
Service Management Position
AMA Tape
120 channels
Data/Voice Hub
120 channels T1/E1/C7
LAN
DSX
Class 4/4-5/5 CO
PSTN

Optional Local Databases

- Directory Inquiry (ACC)
- Automated Yellow Pages (ACC)
- Enhanced E911 / E999
- Answering Service
- Fault Reporting
- Property / HOBIC
- Collect Call Management
- Mobile / Marine Radio
- Credit Card
- Customized Intercept
- Booked Call Service
- Debit Card
- Notification Services
- Well Care Service
- Wake-up Service
- Operator Multi-Leaf
- Rate / Route Tables
- TRS (Relay Service)
- Call Screening
- Precedence/Preemption

T/I LABORATORIES INC.
E-DOTS
TIL
Configurabel Workstations
AT&T2 DRW 02/28/97

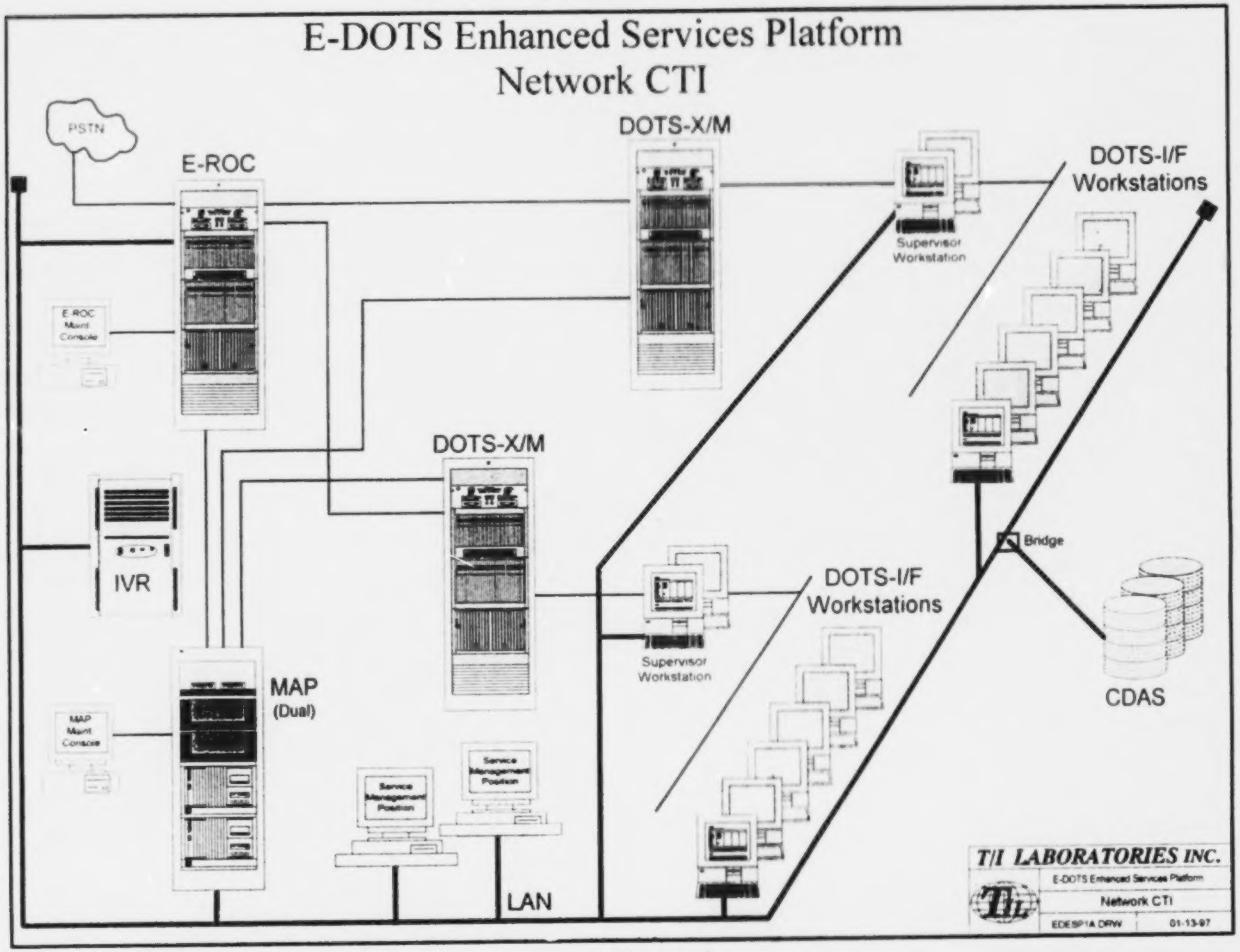

E-DOTS Enhanced Services Platform
Network CTI
PSTN
E-ROC
DOTS-X/M
DOTS-I/F
Workstations
Supervisor
Workstation
E-ROC
Maint
Console
DOTS-X/M
IVR
Bridge
DOTS-I/F
Workstations
Supervisor
Workstation
CDAS
MAP
(Dual)
MAP
Maint
Console
Service
Management
Position
Service
Management
Position
LAN
T/I LABORATORIES INC.
E-DOTS Enhanced Services Platform
Network CTI
EDESP1A DRW
01-13-97

Figure 4

state of the art information technologies (which include telecommunications and computers) a developing country can create its own indigenous telecommunications industry. This can occur and is occurring by the formation of strategic alliances, joint ventures, and business relationships with entrepreneurial fast moving high technology companies of the developed countries. These companies are able and willing to provide technology transfer and knowhow. The traditional telecommunication companies are not geared in that direction. In addition, the new innovative international carriers are usually entrepreneurial and can readily form alliances to provide new and competitive services.

The developing countries and newly industrialized states will find that the high technology companies and the new telecommunication service providers of the U.S. are willing to consider the trade of technology and know how for investments and expanded markets. Such companies are researching, developing, manufacturing and/or offering digital switches, satellite communication systems, radio frequency components/wireless technologies and information and operator services systems. The PTC would be instrumental in facilitating such relationships on a more formal basis between U.S. based entrepreneurial companies and the telecommunication service providers of the developing countries and newly industrialized states.

This paper has covered one area of the many technologies available that can assist in the implementation of new telecommunication services and enhancements of existing services and networks. It can be used as input to those in decision making positions in the developing countries and newly industrialized states for the implementation of their information and operator services.

The key recommendation is to insure that the traditional and new telecommunications service providers of the countries are aware of all the major options available and are flexible enough to take advantage of the new technologies offered by the entrepreneurial high technology companies.

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The Year 2000 Dilemma: Fact or Fiction ???
"How to Manage One of the Greatest Issues since the Ending of the Cold War."

Angelo M. Sánchez
Managing Director
The AMSG Group

ABSTRACT

Estimated to cost upwards of $600 Billion worldwide, resolving the Year 2000 problem poses one of the great economic and technological issues facing the world's governments and businesses since the Cold War which threatened to destroy our economic fiber. If the Year 2000 problem or better known as "Y2K" in information technology jargon is not resolved or ignored, it would have the effect of bringing to a standstill information technology dependent businesses, industries, and governments. This paper will provide the reader with an overview of the Year 2000 Dilemma and potential approaches to assuring that his/her organization's information technology functions on January 1, 2000.

1. THE PROBLEM

Many have oversimplified the problem as the changing of the two digit date field (e.g. '98, '99 etc.) to a four digit date field to accommodate the new millennium. If the date field is not expanded, all non-compliant Y2K applications will interpret '00 to mean 1900 and invalidate all information associated with such a date. Identifying and changing actual date fields would be the simplest part of any Y2K compliance process. Of importance that is more critical are the secondary date fields, routines, and sub-routines that populate date fields from a myriad of other fields and input depending on the size and complexity of the application. In all, converting systems to Y2K compliance is could be similar to rewriting a system in a much shorter amount of time.

1.2 ASSOCIATED COMPLICATIONS

Complicating the resolution process are the following factors:

- The lack of appropriate application and systems document especially in the older "Legacy" systems and even new systems
- Correctly identifying all the date fields
- Correctly identifying all the routines which are linked to the date fields
- Possessing an effective methodology to analyze and implement a solution to the problem
- Identifying the most effective tools to analyze and assist in the conversion of a particular application
- Estimating the extent of Y2K conversion for given systems and application portfolios
- Estimating the resources and budget for a Y2K resolution
- Obtaining Y2K trained resources for a Y2K resolution

The last factor is a probably the greatest issue of all. Given the explosive growth of new information technology products and services especially those related to the growth of INTERNET services and the replacement of the "Legacy" systems, there exists an extensive gap between available information technology resources and what is needed to fulfill these requirements. With the Y2K problem, the gap has grown at an exponential rate. Difficult decisions are now being made between development and resolving the Y2K problem in most industries in terms of financial and human resources availability. This is a worldwide issue and as reports have stated traditional resources for IT personnel such as India and the Philippines may have been exhausted at the time of this writing. The question for most companies and governments has been and will continue to be what to do and who to turn to for a viable solution.

1.3 Y2K REALIZATION AND ACTUALIZATION

When first confronted with the situation a many a COO, CFO, or CIO have many responses to the Y2K problem. Among the more popular responses are the following:

- **"We don't have a problem since all our systems are new."**
- Assessments on 2- 3 year old open architecture systems have shown that although not as pervasive as older legacy systems, these systems have had 10-20% of the code not Y2K compliant and these systems would also be prone to failure.
- Maintenance agreements supplied by vendors in most instances do not include clauses for Y2K compliance. Companies need to have Y2K compliance in all their warrantees, guarantees, and maintenance agreements with software vendors. This should also include penalties related to business losses if undiscovered non-Y2K compliance cause problems after Y2K. In any case, an independent assessment on the Y2K compliance of your "new" systems is the best insurance to really understanding Y2K risk and vulnerability.
- "**We have a lot of time before 2000 gets here**". Systems are highly complex and many systems are not documented well enough to fully comprehend the Y2K implications. If a company's systems portfolio contains various languages, are over 10 million lines of codes, and are highly date sensitive and dependent, that company will have a very difficult time reaching a Y2K compliance solution.
- "**I will be retired by then**". Immediately check the retirement date eligibility of all managers in charge of your ISO function, especially if Y2K action plans have not been developed. Then take appropriate action.
- **"Someone will provide a silver bullet"** (The Miracle Solution) Those who understand the problem, its complexity, and the difficulty of becoming Y2K compliant, know that there are no magic cures or miracles in the offering

2. A MYRIAD OF Y2K SOLUTIONS PROVIDERS

A kaleidoscope of solutions, vendors, methodologies, tools, and consulting services are available on the market. Choosing the right combination mix or solution provider is a taxing and most difficult challenge. From the Big Six, the large systems integrators and hardware providers to software companies, the solutions appear to be there. Sorting these out and evaluating various proposals will be the unwelcome, thankless, and dutiful tasks of management, especially when one remembers that the process will lead to "just" a Y2K compliant system. There will be neither enhancements nor any measurable advances in the proficiency of the system. The only benefit realized will be that the systems will work on January 1, 2000.

2.1 APPROACHES AND METHODOLOGY: AVOIDING "MYTHODOLOGY" AND "EMERALD CITY SYNDROME"

We will review some of the main approaches, tool sets, and methods to implement a Y2K compliance project. We will also examine what to avoid and what to aggressively pursue. We will examine the role of "Fuzzy Logic" tools in quickly assessing an application's Y2K compliance and the characteristics of tools useful in converting systems. Tools will be the one of success factors in any Y2K solution given the need to overcome some of the lack of trained human resources and the limited amount of time left to the year 2000. However, tools are not the solution but just part of it.

As we quickly near the year 2000 and the runway for implementing plausible approaches or solutions becomes shorter, the greatest problem will be apathy and an unconscious hope that the problem will resolve itself or that some kind of "magic box" will be available in a just in time fashion. Although somewhat dramatic sounding, it is just like the cancer patient waiting for the miracle cure. It is the belief by all of us trying to resolve this problem that the patient must acknowledge he/she has cancer and to what extent before a "cure" can be prescribed and successfully given. The essential objective of this presentation is to make the listeners aware of this potentially fatal problem to their respective organizations. If this alarms the reader, we have just entered the first stage of a potentially extensive but very necessary process.

Like the biblical texts, many "messiahs" (vendors) will appear with various solutions that may or may not work. The only true path towards implementing a Y2K solution will be those solutions using a proven methodology that is flexible enough to accommodate both tools and manual resources. Tools in many instances are not the critical success factor in Y2K projects. In some instances, it is more efficient in terms of time, resources, and cost to do Y2K projects using only human resources than using tools. The key

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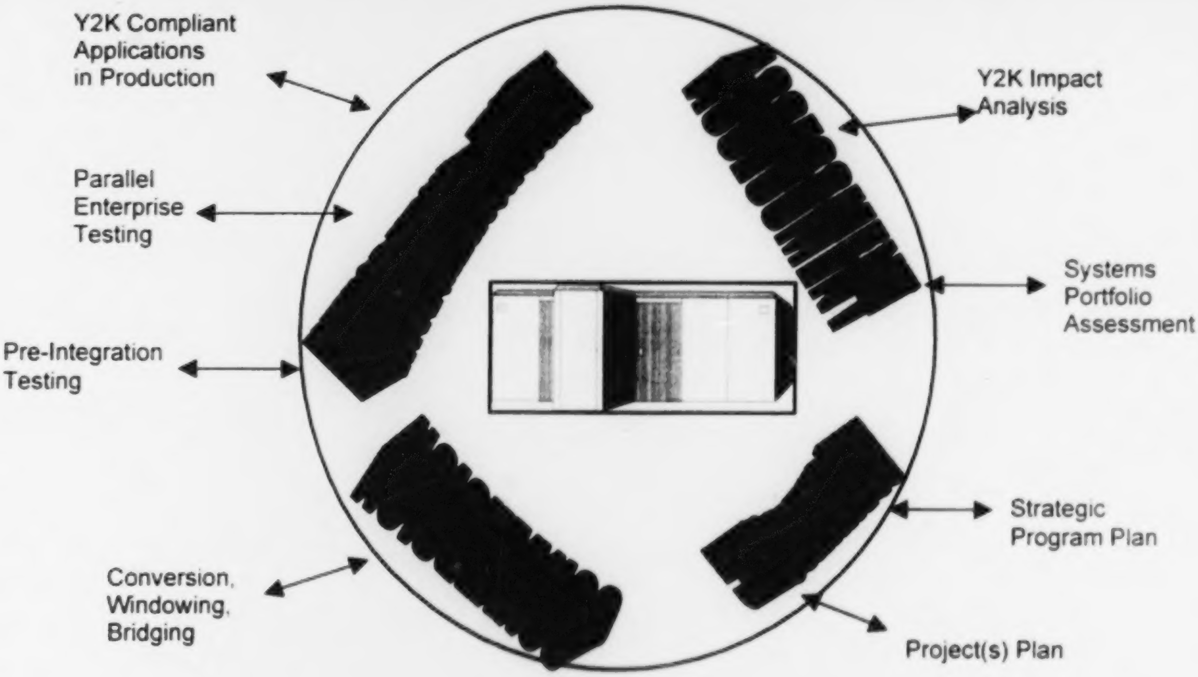
Y2K Compliant Applications in Production
Y2K Impact Analysis
Parallel Enterprise Testing
Systems Portfolio Assessment
Pre-Integration Testing
Strategic Program Plan
Conversion, Windowing, Bridging
Project(s) Plan

FIGURE 1

factor is a strong methodology which can provide assurances that the project correctly identifies all date associated fields, plans the project to optimize time, and tests (and re-test) the software applications under simulated and real time conditions. One must always be cognizant that the existence of any two digit date field in a Y2K "converted" system can be highly dysfunctional if not fatal to the entire system. Figure 1 is an example of an integrated methodology.

2.1.1 ASSESSMENT

Assessment is the most critical portion of the any good methodology. It is here where all the date and associated date fields are identified and lays the foundation for the strategic planning of the entire project. Basically the size of the problem throughout the entire portfolio is defined.

2.1.2 Planning

Planning defines the approaches given the size of the portfolio, its complexity, the time remaining to 000, the amount of resources available, and the maximization of cost reductions within safe limits.

Here the life cycle of various systems is determined to determine the feasibility of immediate replacement of such systems and the associated migration of essential data. Each system in the portfolio is assessed to the viability of entering a Y2K conversion or whether to use other techniques to continue its use through utilizing other systems to convert its two digit field to four at the user interface without disrupting the entire systems(s). Tools, techniques, and types of human resources as well as cost assumptions are defined in this phase. Some believe that as Y2K Compliance work is progressing that other systems or application improvements can be integrated. This adds more complexity and it is not recommended.

2.1.3 CONVERSION

Conversion is the implementation of the strategies and tactics defined in the Planning phase. The utilization of tools and human resources is implemented with constant quality control and project management procedures. Critical in this phase is the tracking the "live production system" as to changes in order to insure a smooth integration at the end of the this phase. A pre-integration test is mandatory in order to assure total Y2K compliance.

SOLUTION TIME FACTOR

(GENERAL)

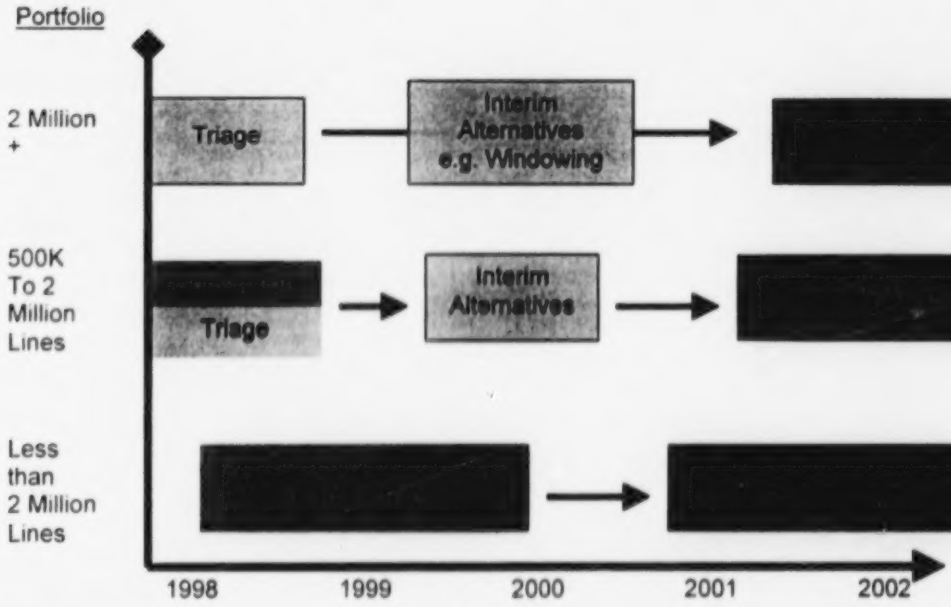

FIGURE 2

2.1.4 INTEGRATION AND TEST

Integration and test migrates and integrates the Y2K compliant system to production mode. New changes that had occurred during the time of Conversion to the live production system are integrated as well as the data bases. Parallel production is implemented to assure all the Y2K compliant systems function exactly like the non-compliant systems. Constant testing and re-testing including stress tests is applied until the Y2K compliant system is clearly functioning within the specification of the original system. Post Year 2000 strategies and maintenance are then planned as required.

If you are familiar with systems development methodology and this sounds strikingly familiar, you are probably right. Y2K compliance methodology is most analogous to systems development methodology. This should enlighten you further as to the magnitude of the solving the problem. One is potentially trying to re-write a new system in the time left to the Year 2000.

3. OVERVIEW OF Y2K STRATEGIES

Three types of strategies or their combination can be utilized in Y2K projects:

A. **Full conversion** – All date related fields are fully converted to four digits

B. **Windowing** – were an overlay of windowing technology converts date related fields to four digits. However, this must be carefully implemented in order to assure that all date fields are included. This technique is CPU intensive and in large systems would increase complexity and maintenance.

C. **Bridging** – a technique in which already Y2K compliant interface applications are bridged to other non-compliant applications. The compliant applications are able to perform the four digit conversion of two digit date fields without non-compliant system degrading or even crashing the entire application. Again highly complex and must be well planned and executed.

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The latter strategies, Windowing and Bridging, are "stop gap" or "Band-Aid" approaches which will enable system to survive the millennium. The objective is to survive until a full conversion or replacement could be successfully completed of all non-compliant systems. Life Cycle of all systems is a critical factor in determining the use of these techniques.

A word about tools: Tools are job aides and nothing more. In some instances they can assist in the assessment but not be helpful in the conversion but can latter be used in the testing phase. Some are geared only to conversion. In some instances a series of tools have to be used in a cohesive manner to reach results. In all, tools must be used selectively and are not replacements for strong methodology. No tool or combination of tools is the "Silver Bullet" to resolve all problems. One clear fact in the Y2K experience so far, the output must always be validated by experienced human resources. The critical nature of Y2K cannot permit the use of any tool by itself, since at any time like all software, tools can be corrupted inadvertently or misused. Only a methodology that checks and rechecks results can be used with Y2K work. Figure 2 illustrates potential planning strategies for various size systems.

Triage is simply the term now used for Assessment and Planning. The significance of this word, which has its origins in military MASH units, illustrates the emergency conditions due to time that Y2K projects have reached. Interim alternatives provide a minimum set of solutions which may permit portfolio to survive the millennium. As we continue in 1998, many of these alternatives will not be available due to time.

More words about tools. As stated previously tools are job aides. However, some tools can be utilized in all phases of the methodology by themselves or in conjunction with other tools. One of the more significant types of tools now being used are those tools based on fuzzy logic or sometimes called "what if tools". These tools are highly valuable with legacy systems or other systems that are not fully documented. These tools with the use of fuzzy logic establish a baseline for "truth" about the identity, redundancy, and pervasiveness of date fields, sub-date fields, and related routines and sub-routines throughout the system. They not only identify the datefields but in some instances are able to convert (with or without other tools) the date fields to Y2K compliance and then are used to validate the fields during testing. It should be noted that they have had a 80 to 90% accuracy level, which means that 20 to 10% of datefields have to be done with manual efforts. Also as stated before, the results of any tool in Y2K has to be validated with professional human resources. The greatest benefit of these tools is that they re-create missing documentation and/or validate older portfolio documentation.

4. MANAGING THE PRICE OF Y2K CONVERSION

Y2k conversions will continue to climb. The United States and Europe are probably the highest in cost. At the time of this writing (1997), the estimated cost of converted line of code is approximately $(US) 1.65. This will probably climb by years end 1997 to $(US) 2.00. Calculating the price of an entire portfolio is related to the age, size, and time one begins the process as well as to the extent applications are not Y2K compliant.

Global prices on the average will steadily climb. However, some regions will surpass the global average such as the United States and Europe since their awareness and use of available resources has happened much sooner. Figure 3 is an illustration of price trends and their future.

The point of unavailability simply means that there will be **no solution at any price** unless there really appears the "silver bullet" which would probably mean even much higher prices. Should an unlikely "silver bullet" appear, it is doubted that the prices would be lower than the projected cost per line and still at that late date guarantee that it is doubtful that it could be trusted to work.

4.1 PRICE SEGMENTATION

Not all the lines of code in a given portfolio will have to be converted. Some will have to be assessed only, while others will have to be converted. All will have to be integrated and tested. The following percentages are a heuristic approach to price segmentation:

Assessment and Planning	**20%**
Conversion	**30%**
Integration	**30%**
Test	**10%**

Again, these are heuristic approaches and the final price will depend on your vendors, the time, and the approaches planned. For example, windowing or bridging may or may not usually be as costly as full conversion but given the time frames the expenses are predicted to be the same. The use of more automated tools usually does not affect the price since, as stated previously, the results have to be validated with human resources. In any case, Y2K compliance will be a very expensive proposition for all.

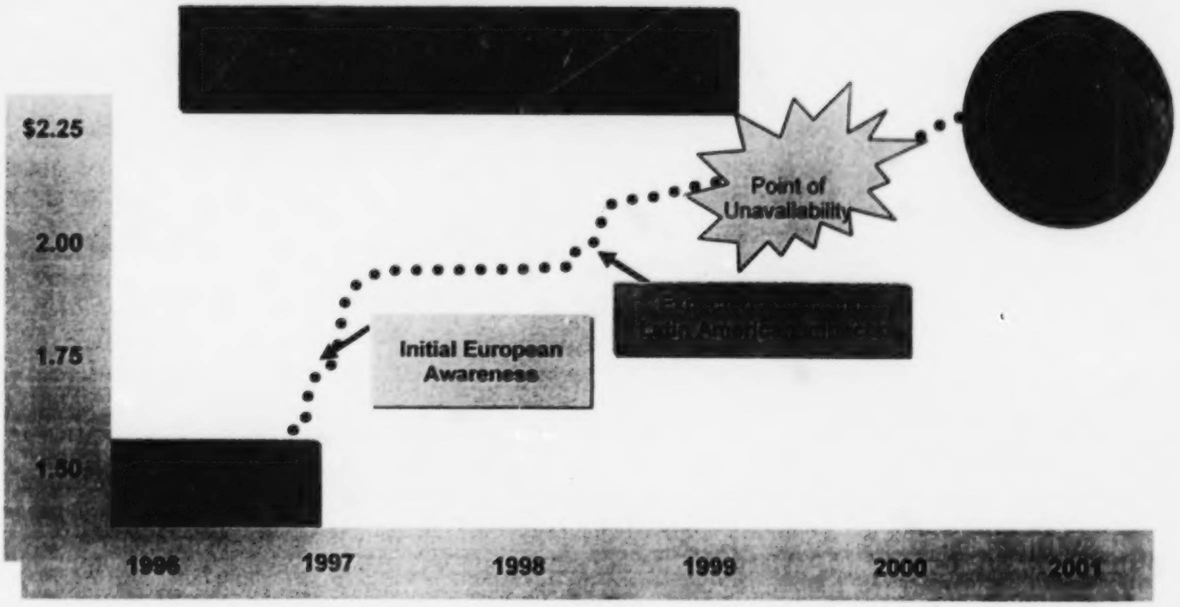

FIGURE 3

5. APPROACHES FOR ASSURING COMPLIANCE

The following are some of the areas which should be followed in order to assure that your company or government agency assures itself of appropriate Y2K compliance:

Start immediately if you have not done so. Establish an executive committee with representation of MIS and other executive heads. Empower the individual(s) leading the effort with power to seek the best and least costly approach.

Seek partnership with other companies or vendors of Y2K for joint ventures in a potential factory setting where work disciplines and methodology can be quickly assembled and work begin in an orderly manner.

If you are a government agency, suggest government policies or involvement to assure that the Y2K is handled on a national level. In the United States, both Federal and State governments are coordinating their efforts to assure that the problem does not affect the economic vitality of the nation nor its national security. In addition, governmental restrictions on cross border data flows may have to be suspended in the case where systems have to be outsourced for Y2K compliance projects in other countries where the resources are available to provide such services.

Choose a vendor with the strictest criteria on references, complete methodology, integrated tools approach, and proven resources to deliver a compliant system. Shared Program management is highly recommended, but project management should be in the hands of the vendor with coordination with key MIS and user group individuals in order to provide critical system knowledge and experience.

In all, the Y2K problem is with us and has to be confronted and solved. Some complete solutions will not happen until after the millennium but as mentioned some approaches will at least provide temporary salvation. One other note, your organization may need to postpone other capital improvements or MIS developments to offset the costs of Y2K compliance projects.

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The Millennium Effect: Challenges and Opportunities for Telecommunications Carriers

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1. ABSTRACT

Issues arising out of the Year 2000 transition, often referred to as the Millennium Effect, are common to all Telecommunication Carriers. The profile of the industry, being a service industry with a heavy dependence on technology makes Year 2000 a critical and expensive hurdle for all carriers. Operating in a multi-vendor supplied and supported infrastructure, makes comprehensive compliance and inter-operability testing a technical challenge seldom faced by any industry. Year 2000 issues, while very daunting, offers excellent opportunities for global co-operation. The paper also discusses long term benefits that could be derived from a well-run Year 2000 Programme.

2. INTRODUCTION

A majority of computer based systems as well as microprocessor based embedded control systems use a two digit representation for year in a date data structure. For example, 1998 is represented and often stored as '98'. This would result the year 2000 being represented as '00', leading to an ambiguity in the interpretation of the century as either '19' or '20' as well as not recognising that 2000 is a leap year. While this may seem to be a trivial problem, the implications for enterprises are enormous, as this ambiguity affects all date sensitive transactions. Telecommunication carriers are particularly vulnerable due to the heavy dependence on complex computer technology and large number of technology vendors, for all aspects of the day to day operation of the enterprise. A reliable telecommunications service is critical to many businesses.

The origins of the problem can be traced to the early 1960s. Programs were written with strict guidelines to conserve very expensive internal memory, disk space as well as CPU cycles. Using two digits to represent year, instead of four, resulted in large savings in storage devices, both dynamic and static, as well as an increase of CPU performance. However such considerations are no longer relevant as CPU performance as well as affordability of hardware have dramatically improved in the last 30 years; in spite of this, programming and management practices focussed on software module re-use seem to have compounded the problem.

3. NETWORK IMPACTS

Figure 1 is a simple generic overview of the components of a telecommunication carrier.

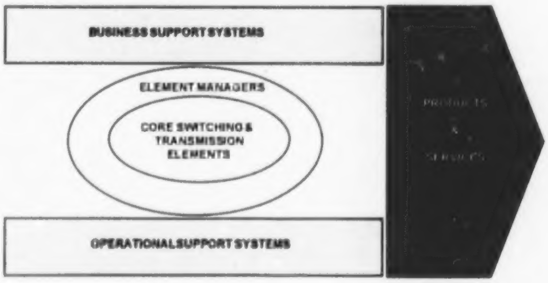
BUSINESS SUPPORT SYSTEMS
ELEMENT MANAGERS
CORE SWITCHING & TRANSMISSION ELEMENTS
OPERATIONAL SUPPORT SYSTEMS
PRODUCTS
&
SERVICES

Figure 1: A simplified Carrier Architecture

The switching and transmission elements form the core of the carrier's network. Element Managers, often supplied by the switch vendors, form the next layer. The carrier's Business Support Systems and Operational Support Systems are designed around these, and together support the carrier's products and services. Each of these are discussed in the following sections.

3.1 CORE SWITCHING AND TRANSMISSION ELEMENTS

The core switching and transmission elements operate in real time, and often there is a sense of comfort that these are not impacted by calendar dates. In fact, real time systems represent dates with a base date specified by the manufacturer and an off-set that represents clock ticks from the base date. Counters that register the offset will at some time overflow, causing the system to either default to the base date or produce unpredictable results. While this may not happen at the turn of the century, it will happen at some time based on the system design. For example most Unix®[1] based systems employ January 1, 1970 as the base date and use a 32 bit offset to derive current time. This scheme is expected to work till January 1, 2038, when the register overflows and may cause unpredictable system state. Global Positioning Systems that rely on satellites, have already been shown to be vulnerable, even before the century transition occurs. Systems that accumulate network traffic patterns for analysis and use it to predict and dynamically control bandwidth allocation should be examined carefully for date sensitive vulnerabilities.

The challenge for the carriers is to identify such issues among the various elements and have in place an appropriate program for remedial actions. A well run year 2000 programme can once for all tackle all such date related issues, even beyond the century date change.

3.2 ELEMENT MANAGERS

Element Managers use standard management protocols (eg. CMIP, SNMP, Q3) to manage the elements in real time. It is likely that these protocols are not impacted by the century date change. However, the Management Information Base (MIB) may contain date related data. Depending on data definitions in the MIB , ambiguities in interpretation of current year may result at century transition.

3.3 OPERATION SUPPORT SYSTEMS (OSS)

Typical operational functions carried out using OSS include:

- Configuration Management
- Alarm/Fault Management
- Performance Management
- Accounting Management
- Security Management

Each of these functions rely on or generate date related information. For example Call Charge Records(CCR) typically carry call start (date and time) and call duration (time interval between call start and end) information. This is used by downstream systems for generation of bills. While the call duration information is used to determine the charge, the call start information is used to sort the charges chronologically. Typical CCRs have a two digit representation for years and as a consequence may result in incorrect bill production.

A more real-time, operational problem may affect the operator's ability to manage the network. Typical alarm notifications carry time-stamps with a two digit representation of year. Any ambiguity in dates seen by management function that correlates alarm information, will cause severe delays in restorative actions, degrading network performance as well as availability.

Instances have also been reported of configuration management as well as security management functions being impacted by century transition. A typical scenario, often quoted, is one where the security mechanism that checks expiry dates on software licences does not recognise '00' and thereby locks out users at the turn of the century.

3.4 BUSINESS SUPPORT SYSTEMS (BSS)

Business functions supported by BSS include:

- Service Activation
- Service Assurance
- Charging & Billing

These business functions are date sensitive. For example Activation functions manipulate Customer Required Date, Disconnection Date etc. Any ambiguity in interpretation of dates will result in incorrect orders being generated and acted on.

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[1] UNIX is a registered trademark of X/Open Company Limited

3.5 PRODUCTS AND SERVICES

The robustness of the products and services offered by the carrier is underpinned by the reliability of the Network, OSS and BSS functions. Any detrimental date impacts on any of these, will eventually have a flow on effect on the Customer as well as the Customer's business. Carriers are being asked by Customers to guarantee Year 2000 compliancy in respect of the network services and products provided to them. This is not a simple undertaking, given the complexity of inter-system relationships and the multi-vendor dependency.

4. GENERIC REMEDIATION PROCESS

Figure 2 is a schematic of the generic Year 2000 programme process flow. The approach is consistent with most Year 2000 methodologies seen to date.

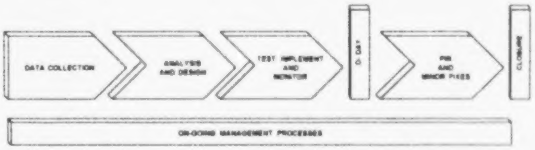

Figure 2: The remediation process flow

Initial phase starts with a data collection activity to create an inventory of all network equipment and systems. All network vendors are surveyed at this time to establish the compliance level of their products. The analysis phase looks at this inventory critically to identify date impacted elements and is used to plan the remaining programme. This phase also involves analysing the business risks of failure for each item in the inventory and is used to develop a risk minimisation plan as well as drive priorities of the overall program. This phase should also deliver a high-level design of the year 2000 compliance solution, generic test plans and test cases for the network equipment and systems.

A consistent view emerging in the IT industry is that 60% of the Year 2000 effort will be spent on compliance testing. This is not surprising, given the complexity of current systems and interfaces. The third phase of activity covers Year 2000 compliance testing, certification and the deployment of certified systems in the network.

It is to be expected that, in spite of best efforts, some residual remediation work will need to be carried out post century date change. The program winds down with a post implementation review (PIR), typically scheduled within six months.

5. POTENTIAL AREAS FOR CARRIER CO-OPERATION

Telecommunication carriers share infrastructure, depend on each others systems for inter-connect and call completion (for domestic as well as international), exchange maintenance, upgrade and billing information, work to international protocol standards and more importantly rely on a common pool of equipment and system suppliers. Given these, year 2000 issues can raise inter-carrier teamwork to a new level to meet the common challenge. Co-operative efforts to minimise overall Year 2000 Programme spend, as well as risks, can include, but are not limited to:

- a common approach to the management of vendor compliancy
- exchange of year 2000 specific test plans and strategies, and where needed a common remediation programme schedule
- sharing of test results on common infrastructure in order to reduce duplication
- forums to share experiences and approaches

Such arrangements can exist at regional, national and international levels.

6. LONG TERM BENEFITS

A well-run Year 2000 Programme can offer significant benefits to the carrier's business, apart from ensuring that there is business continuity at the century transition. By creating an enterprise wide inventory of all elements and systems, the programme is well positioned to rationalise and simplify the carriers technology environment. In most cases, this can also result in better management of valuable network assets. In addition, the programme can also bring focus to those less well known, but essential support elements of a carrier's business: security access mechanisms in buildings, lifts, air-conditioning, emergency power generators and in general any management function based on systems that manipulate or rely on date and time.

7. CONCLUSION

The year 2000 transition will have profound impacts on all business that rely on technology and telecommunications carriers are particularly vulnerable. While the challenge is daunting and the time to act is getting shorter, there are unprecedented opportunities for inter-carrier co-operation. A dedicated Year 2000 effort can bring tangible benefits to the enterprise well into the next century.

8. REFERENCES

[1] Bellcore (1996). *Year 2000 Generic Requirements: Systems and Interfaces*. GR-2945-CORE

[2] Chaabouni, Moez (1997). *A Framework for Testing Year 2000 Application Conversions*. In paper archives at http://www.year2000.com.

[3] De Jaeger, Peter (1997). *You've Got to be Kidding!* In paper archives at http://www.year2000.com.

[4] Bellcore (1996). *Is Your Network Ready?* Bellcore whitepaper. In paper archives at http://www.bellcore.com

[5] Blau, John and Johnston, Chris. (1997). *Phone System Braces for Bomb*. Communicationsweek International, 2nd June.

Creating Competitive Advantage for Telecommunication Operators Using the Internet for Self Help

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1. Abstract

This paper reviews the application of Self Help concepts within the communications industry. In particular the paper will focus on the opportunity for incumbent and new operators to tap into the explosive growth of the Internet and Intranets to provide Web-based customer support.

2. Background

The advent of de-regulation and competition in the Asia Pacific communications industry has brought significant challenges to both incumbent and new carriers alike. Both have sought to improve internal productivity, reduce operating costs, improve customer service levels and dramatically speed up time to market.

As the operating technologies are reduced to commodity levels, competition is based on providing excellent customer service. Thus both incumbent and new carriers need customer-centric systems to support their key investment and operational business objectives, especially the delivery of the exceptional customer service which is the key market differentiator.

Many services like mobile phones are offered to consumers indirectly by external organisations such as dealers. Connecting these organisations to service activation systems using self service technology is also a high priority.

2.1 Purpose and Scope

The paper sets the context by examining some key trends in the telecoms market, trends that not only exacerbate current competitive pressures and needs for change, but go much further, in breaking down traditional approaches to the delivery of customer service.

The paper then outlines how Oracle is working with its key telecoms customers in the Asia Pacific Region to help them link their internal business processes with those of their key customers, suppliers and distributors to create greater customer intimacy.

2.2 Key issues

Systems are supposed to provide cost reductions, efficiency, speed of competitive action or response on product and price offerings, process improvement and integration, improved internal and external communication, improved billing, fraud and credit control and a host of other benefits, which all contribute to competitive advantage.

However, experience shows that there are four areas that any new systems approach needs to focus on to achieve real - and timely - success by enabling the delivery of excellent customer service:

- The ability to not only respond to competitor activity but also to pro-actively set the market pace.
- The ability to incorporate new systems requirements flexibly and rapidly.
- A cohesive systems architecture that will support the business objectives as they change over time.
- Integration of all systems to enable the business to be truly customer responsive.

These requirements become even more crucial when operators move to provide automated Self Help to their customers and distributors.

2.3 The Networked Society

The way we do business, learn and conduct our lives is changing as a result of the convergence of computing, communications and content. Universal access to vast quantities of information and sources of goods and services is creating a global electronic village and bringing with it a new economic order, indeed, a radically new economy, based on a networked society.

Computer Telephony Interface (CTI)

Telcos have been experimenting with, and implementing, CTI based applications. An example of the use of CTI technology is with customer service management systems, used by telecommunication companies throughout Europe and England, that care for everything from order taking to billing for such services as call waiting, call barring, and 3-way calling. In some companies, the CTI portion of the system is accessible only by a service representative; several other companies have added front end IVRs to the system to allow the customers to activate and de-activate their own services using a touch-tone telephone.

Internet Services and Electronic Commerce

Web sites are being used much more frequently to inform and educate customers about product and service offerings and provide fax on demand. The Internet is also an ideal platform to provide customer support. Traditionally, customer service personnel are typically reached via an 800 toll free number after a customer is put on hold. The Internet offers a more efficient way to provide this first level of customer service. The customer could access a company via the Internet and if the problem cannot be solved by the customer finding the information at the company's Web site, a live customer service representative comes online with a solution.

Another key advantage of Internet-based access is the ease of linking internal users as well as external users to existing information systems. Some telcos are marrying a Web browser and a search capability to their own systems and allowing agents to quickly access information about the availability of network facilities. They also indicate that the time to develop this type of application is significantly less than with traditional development methods.

This mechanism is perfect for distributing rapidly changing information such as mobile phone coverage maps, White and Yellow pages information. In fact, because of keyword searching and the ability to link the information to maps and other Web sites on the Internet these systems can easily be made to be more functional and preferable to the books and brochures they replace or augment.

6. Issues in Web-based Customer Service and Support

The marketing, offering, and distribution of customer service and support over the World Wide Web is a relatively new phenomena. A number of factors are rapidly converging to thrust Web-based customer service and support to a position of elevated priority within the service strategies of telecom operators. These include:

- The widespread, rapid growth of the Internet, World Wide Web, and corresponding user base have mandated that companies create a Web-based presence via home page sites for informational, marketing, advertising, service, support, and other purposes.
- Customers have an increased reliance upon communication facilities and their uninterrupted availability.
- Customer frustration with ineffective and/or overloaded customer service phone support systems that are unable to deal with the flood of incoming calls efficiently; compounded by high support costs, staffing, and logistical issues.
- Rapidly shrinking product life cycles that produce increasingly frequent waves of new services and features to be absorbed by users, create corresponding increases in demand for support, education, training and consulting services.
- Technological enhancements in the areas of telecommunications equipment, multimedia capabilities, intelligent software, database applications, and Web site features and functionality have made Web-based service and support more attractive.
- Global competition and related pressures have made online support a necessity.

The external Web site can be the one central repository where all corporate knowledge is collected and displayed for all to see as common problems are identified and resolved. For possibly the first time, a company can develop a visible and pro-active corporate memory for each customer.

The successful companies will ultimately be those that are able to understand the needs of their customers and utilise emerging technologies and service methodologies to meet those needs, gain correspondingly stronger customer relationships, and ease or eliminate the burdens and frustrations normally associated with providing customer support. These service providers will personalise their service, make it easy and convenient to access and use, and price it competitively in relation to more traditional forms of support

6.1 Web-based Self Service Strategy

Telecom operators strategies and positioning for Web-based customer support services for the next one to three years generally reflect the following themes:

3. Challenges

In this environment of change, telecom operators, old and new, need above all to be flexible in order to adjust to what is still an emerging new order. The work that Oracle it is doing with operators in the Asia Pacific region is focused particularly on four areas:

Time to market for new products and services

Competitive markets demand new innovative product packages. Product cycle times are reducing and mass-customisation of products is becoming the norm, while end-user business units and their customers are increasingly frustrated with constraints imposed by existing systems and business processes. At the same time, management is increasingly concerned at the cost and delays associated with in-house systems development and the resultant proliferation of stand alone product specific systems.

Increasingly, in a networked economy the consumer will expect even large organisations such as telecom operators to treat them as an individual and to adopt one-to-one marketing strategies to proactively meet their needs.

Maintaining market share in the face of increasing competition

Telecom operators have a wealth of information about their customers securely locked away in multiple transaction processing systems. However, while the key to accurate market segmentation and customer profiling is gaining access to accurate customer data, the current customer data is often inconsistent due to the multiplicity of customer management systems. Telcos need a 'whole of customer' view including all their product and service usage across all networks. Ultimately they also need to understand which customers are more profitable.

Providing excellent customer service for competitive advantage

As communications infrastructure and facilities become a commodity, the key market differentiator is customer service. Current systems generally provide an inconsistent view of customers and the products and services they utilise. This coupled with customer dissatisfaction with multiple hand-offs and high levels of rework, highlights the need to provide a 'one stop shop' approach and to 'get it right the first time'. The focus must be towards providing integrated product packages with consolidated billing and away from discrete products with simple billing.

In fact, in the network economy the customer can be put to work by accessing these large databases of information. Customer service is all about giving customers access to the necessary resources to get the job done. There are many examples on the Web across industries, such as Federal Express, that are now being applied to Communications. However, the systems are often much more complex and the applications such as customer provisioning are considerably more challenging then most of the current Web applications.

Financial Management and Reducing Operating Expenses

Price competition is eroding product and service contribution margins and current high levels of fixed and allocated costs make it difficult for existing operators to achieve a cost base that is competitive with the new start-up operators. This is exacerbated by the resource wastage associated with high levels of rework and inadequate internal controls that also make it difficult to comply with audit and reporting requirements. Self Service is all about cost reduction without lack of customer service. These two rarely go hand in hand.

4. Solutions and Approach

In order to remain competitive, telecommunications organisations are increasingly being required to support flexible and changing business processes and to reduce the costs and limitations imposed by diverse application and technical architectures. Information needs to be shared both within an organisation - between marketing, customer service and networks for example - and increasingly outside of it, with customers and partners both world-wide and nationally.

In addressing these challenges, telecom operators increasingly are approaching their business systems holistically, rather than in isolation. They are taking a number of steps, including:

- Sharing the business problem with selected vendors to gain from their experience instead of relying exclusively on in-house thinking.
- Reviewing data requirements of the total enterprise using tools such as the Oracle Enterprise Data Model (a component of the Oracle Telecom Enterprise Information Architecture).
- Reviewing critical business processes to ensure they are adequately supported by appropriate information systems.
- Identifying quick win niche solutions whilst working on longer term integrated solutions.

- Surrounding existing legacy environments to provide increased flexibility without the need for wholesale replacement strategy (incremental change).
- Extending internal business processes to include customers, suppliers and distributors through the use Web-based technology.

To address the challenge of market share maintenance, many telecom operators are implementing common front-end systems for all customer facing staff, to give them access to all relevant information in real time to support dialogue with the customer. Some are also extending access to these front-end systems to provide key customers and distributors with direct electronic access.

5. Self Service in the Communications Industry

5.1 Background

The purpose of this section is to review communications company experiences with Self Service and to provide insights into key trends that will impact future Self Service initiatives.

Self Service refers to the ability of an individual to conduct a transaction with a provider of service without the intervention, in whole or in part, of a service representative. Communications companies in the United States and Europe have been experimenting with Self Service technologies and applications for over ten years.

Early enabling technologies of Self Service include Interactive Voice Response (IVR), voice recognition, and touch screens. More recently, technologies such as PC's, Computer Telephony Integration (CTI), and Internet-based access are enabling further advances in the field of Self Service. It is generally true that these and other technologies are being used more aggressively by other industries, such as banking, retail, airline, travel, and insurance.

As enabling technologies evolve, Self Service applications are becoming more widely available, usable and acceptable to most segments of the population. Telcos report benefits such as service centre cost reduction, productivity improvements, increased market penetration, increased levels of customer satisfaction. Individual Telco customers report benefits such as greater schedule flexibility, shorter transaction time, and access to more information.

Candidate applications for Self Service include the following:

IVR for Consumer Customers

- account balance, status inquiry, payment options
- requests for bill reprints
- inquiry to customer loyalty programme
- self provisioning of simple service
- faults inquiry

Internet for Dealers and Corporate Customers

- initiate work request and track progress
- service enquiries, customer feedback
- product and service information
- electronic directory service (white and yellow pages)
- central office feature orders (Centrex, call-waiting, call-forwarding, 3-way calling)
- adds/moves/changes
- view, analyse and process billing data
- electronic data transfer of billing information
- billing enquiries, bill status, analysis and payment
- fault reporting and testing
- trouble report tracking
- service centre call routing
- electronic commerce
- dealer management reporting

Internet for Consumer Customers

- "flagship" service
- full automation and reporting
- catalogue shopping, product information and guides, enquiries and purchase
- billing enquiries, status, analysis, payment approval

5.2 Experiences with Self Service Applications

Interactive Voice Response (IVR)

Telcos are increasing the efficiency of their residential customer service centres by up to 20% by re-routing misdirected calls, through the use of an IVR-based menu at the beginning of the call. Further productivity increases are being realised with the use of CTI that retrieve and present customer information to the service representative at the same time the call is answered.

Many telcos are using IVR based applications to allow customers to report troubles. During the course of the transaction, the application conducts various line tests on-line, so that by the time the call reaches a repair technician, simple options are already addressed and eliminated.

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Business Model

Improving the business model generally involves concerted efforts in the areas of marketing, operations, and finance.

From a marketing perspective, service providers are intent upon becoming more efficient and effective at marketing Web-based customer service and support services to both existing and potential users. In some cases, the objective is to make the customer more aware of what the company offers via the Web. In other cases, the strategy involves either a planned shift of a certain percentage of support from the phone to the Web, within a particular time frame.

From a profitability position, service providers have mixed views regarding the current performance of their support operations. The short-term view favours utilising Web-based support to maintain overall customer service and support levels, whilst breaking even (or potentially losing money) on the Web operation. The rationale for this approach is that Web-based support is a long-term investment that will eventually yield long-term payoffs.

Service Model

Improving the service model generally involves the following initiatives:

- Foster greater personalisation and inter-activity. The current Web-based model is built on a response model concept in which a customer contacts the service provider when they have a new service need or a problem to fix. The newer model involves greater proactive communication and prevention that are exercised on a continual basis in accordance with the customer's profile and preferences.
- Increase customer self-reliance. Customer self-diagnosis will be considered the first line of support in the future. It will therefore be necessary to provide customers with access to more information, features, functionality, diagnostic utilities, and access choices to foster customer participation and problem resolution success.
- Integrate services provided. As currently structured, services are often provided to the customer in a disjointed manner. Greater consistency and leverage would accrue from a more integrated approach.
- Evolve with the technology. Web-based support will continue to improve as its enabling technologies improve. Examples include the move from client/server to network computing and the use of PCs as a conduit for voice and video communication.

Enhance Customer Relationship

Companies are rediscovering the critical importance of simply talking to their customers and understanding customers' needs and requirements on a very deep level. Service provider tactics for achieving a stronger bond with their customers involve operational and service delivery improvements, the proactive setting and management of customer expectations, and strategic partnering with customers to become an extension of their operation.

6.2 Innovation and Speed of Response

To achieve these general strategies two factors are critical to success:

- Fostering innovation is considered a primary factor critical to success for improving and enhancing Web-based customer service and support. It is also critical to identify specific enhancements that incorporate user feedback throughout the innovation process.
- Speed is a critical factor in attracting customers to, and delivering, Web-based support. Because resolving problems is not a value-added activity for most companies, users will use Web-based support only to the extent that it is faster and more efficient than phone support or other methods. Fast system performance from a technological sense, combined with fast response time to user queries, is the key. Integration of all forms of service is vital, the customer activity log must transcend IVR, Telephone and Web Self Service systems.

7. Self Service Business Drivers

7.1 Corporate & Large Business Customers

Providing Internet/Intranet access for provisioning by the Corporate and Large Business market will pave the way for earlier adoption of electronic commerce, and will also:

- Ensure 'around the clock' access to Telecom services thus allowing Corporate customers to quickly expand key service elements
- Eliminate the need to 'hold' for a Customer Service Representative for simple and repetitive tasks
- Provide self provisioning of configurable services, eg. Centrex
- Improve the reality or customer perception of service quality
- Enhance brand image of the telecom operator as being in the 'leading edge' of service providers within their market
- Encourage billing and payment by electronic media thus accelerating revenue collection

7.2 Business Customers & Dealers

Small businesses and, most specifically, Dealers will benefit from the expanded access to the telecom operator's core processes through the Internet/Intranet. With the shift world-wide to electronic forms (thus eliminating paper-based communication) and automatic flow through service activation, simple configurations can be best provided by the Internet/Intranet access model.

This increases customer satisfaction and loyalty by:

- Increasing the pace of transactions from the Dealer network
- Increase the end-user's satisfaction with the purchased service as the end-user can obtain 'immediate' activation before leaving the Dealer's premises
- Allowing the tracking of work in progress from Dealers
- Ensuring 'around the clock' access to telecom services by both Dealers and Small Businesses
- Eliminating the need to 'hold' for a Customer Service Representative for simple and repetitive tasks
- Improving the reality or customer perception of service quality
- Enhancing brand image of the service provider as being in the 'leading edge' of telecommunication service providers within their domestic market, and internationally.

7.3 Consumer Customers

In the short term cost containment objectives in the consumer market are more likely to be met by the introduction and expansion of use IVR technology and by integrating IVR functionality with the core customer support business processes.

8. Network Computing Architecture

8.1 The Networked Society and Network Computing Architecture

The explosive growth of the Internet and Intranets has provided a common global infrastructure to fuel a "networked society" that spans individuals, small businesses, governments and multinational corporations. The maturing of this infrastructure (see Fig. 1) signals a new phase of network computing that involves real business transactions, data-driven multimedia content and interactive information access via self-service Web applications. In response to this phenomenon, Oracle announced Network Computing Architecture (NCA), a comprehensive, open, standards-based software platform.

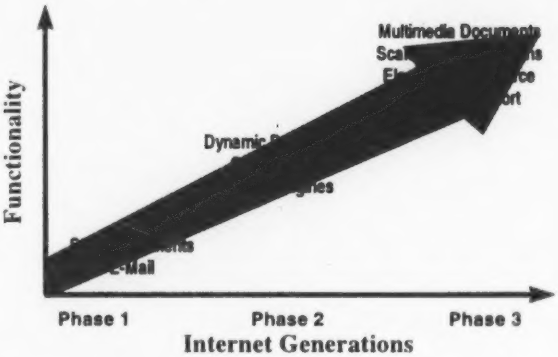

Fig.1 Evolution of the Internet

The impetus for Network Computing Architecture came from two different sources, what we will call the Developer's Dilemma and the Business Dilemma.

Developer Dilemma

The Developer's Dilemma involves an increasing choice of incompatible standards, tools and technologies. Technologies such as HTTP/HTML, CORBA, IIOP, ActiveX, DCOM, Java, etc. offer unique possibilities for enhancing developer productivity or providing new capabilities to users, but which technology should I support ? Ideally what I want to be able to do is to leverage the best of each environment with relatively little compromise.

Business Dilemma

The Business Dilemma comes from the problem of how to adapt new technology to real business applications. How do I take advantage of the benefits of new technologies whilst still maintaining my significant investments in client/server and legacy environments?

Network Computing Architecture™ is a common set of technologies that will allow all PC's, Network Computers and other client devices to work with all Web servers, database servers and application servers over any network. Network Computing Architecture is the productisation of Oracle's vision for network computing, and will help companies protect their technology investments by allowing mainframes, client/server, Internet and Intranets, and distributed object software to work together.

8.2 Three Tier Architecture

Oracle's open Network Computing Architecture (see Fig. 2) is based on a three tier architecture:

- Universal Client which can be any device ranging from an Network Computer to a PC
- Network based Application Server
- Network based Universal Data Server

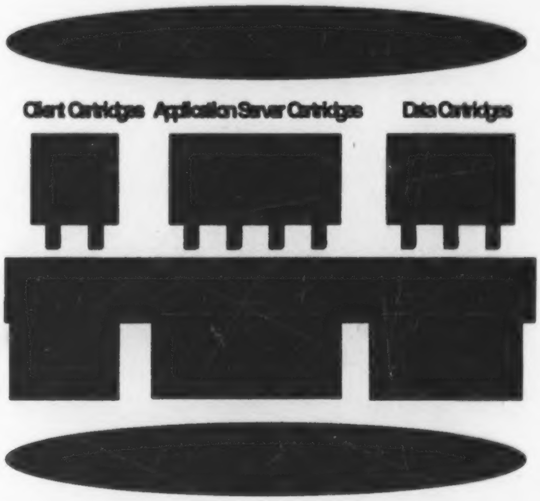

Fig. 2 Network Computing Architecture

This approach which involves hosting the application and data on network servers rather than on the PC client, enables thinner clients to be deployed compared with traditional client-server two tier architecture. As well as requiring less expensive client devices this configuration is expected to be much easier to manage. Preliminary estimates by Oracle indicate overall savings of the order of 50% to develop and deploy an application using NCA compared to an equivalent client-server application.

By supporting Internet Web standards as well as traditional client-server Graphical User Interface (GUI) standards, NCA also enables existing applications to be Web enabled and delivered via the Internet to telecom operators customers, suppliers and distributors. This enables operators to extend their business processes to incorporate their entire supply chain (electronic commerce).

NCA is intended to complement the existing legacy computer environment by providing linkages to existing applications and data running in this environment. That is, NCA can be used to not only develop new applications but to complement and extend existing applications obviating the need for wholesale replacement of legacy systems.

Key components of Network Computing Architecture are:

- "Pluggable" objects called cartridges that are manageable and provide extensible functionality
- Open protocols and standardised interfaces that enable communication among cartridges through a software bus called Inter-Cartridge Exchange
- Extensible clients, applications servers, and database servers.

8.3 Enhanced TV

In the consumer environment, blending the traditional television experienced with the capacity of the Web to provide online chat sessions, electronic program guides, email and even electronic commerce will be the bridge that enables the bulk of consumers to cross into the online experience from their couch. Hence, they will also have easy access to Telecom Self Service applications.

Enhanced TV is the set-top box of the past but with the ability to seamlessly run the content standard of the future - the Internet. These low-end Network Computers or NC's will link each household to Telecom provided services and beyond.

9. Case Study

9.1 Introduction

The commercial pressure for Self Service is growing and is different for the Corporate, Business and Consumer market sectors. Corporate customers demand improved service quality and reduction in transaction costs. Business customers and telecom dealers need improved sales effectiveness through screen-based Self Service and paper-less, electronic commerce. Telecom operators' Call Centre costs need to be contained while maintaining customer satisfaction.

9.2 Technical Architecture

A systems architecture (see Fig. 3) is required that:

- Supports multiple access methods
- Records Self Service transactions regardless of access method (eg. Customer made a Billing Inquiry using the Internet/Intranet)
- Reuses existing or planned business functionality and data by multiple access methods
- Reuse of the same technology for Self Service as for Customer Service Representative lead sessions

- Recognises the unique abilities and limitations of each access method.
- Provides for the integration for multiple access methods
- Reuses models for analysis, design, and build that enforces consistency while minimising the unique access method impact on core systems.

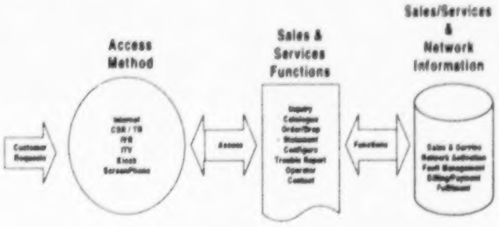
Access Method
Sales & Services Functions
Sales/Services & Network Information
Customer Requests
Internet
IVR
ITV
Kiosk
ScreenPhone
Access
Inquiry
Catalogue
Order/Shop
Statement
Configure
Trouble Report
Operator Contact
Functions
Sales & Service
Network Activation
Fault Management
Billing/Payment
Fulfilment

Fig. 3 Oracle's Self Service Context Model

Oracle views the technical architecture requirements for Self Service as a component of the telecom operator's corporate architecture. The Self Service access requirements do require additional architectural components. These are additive to the telecom operator's Enterprise Information Architecture.

The following is an example of how Self Service capability can be added for an existing major Oracle client in Asia Pacific.

The architecture (see Fig. 4) illustrates how the implementation of self-service enables the telco to leverage it's investment in existing and planned front office and back office systems.

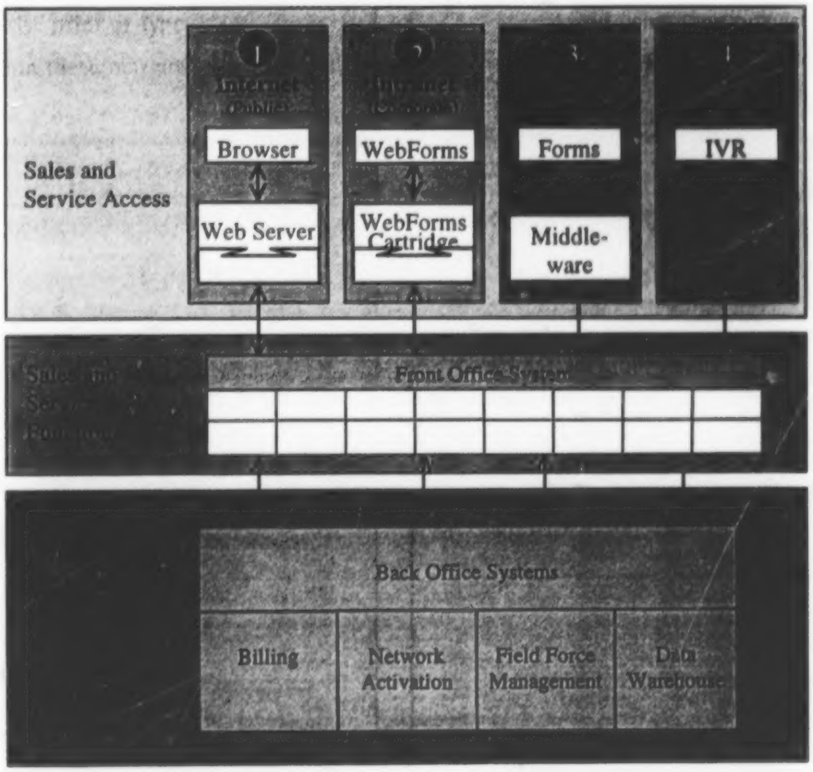
1
Internet
(Public)
2
3
4
Browser
WebForms
Forms
IVR
Sales and Service Access
Web Server
WebForms Cartridge
Middle-ware
Front Office System
Back Office Systems
Billing
Network Activation
Field Force Management
Data Warehouse

Fig. 4 Self Service Systems Architecture

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9.3 Internet Access

The first option extends the Self Service solution to the Internet for consumer access. This option generates HTML front-ends that are rendered by standard browsers and the necessary business services on the back-end through the use of the Oracle Designer 2000 repository. The generation techniques used in this option allows for immediate deployment of existing applications with little or no re-development efforts. The entire solution is based on proven Oracle products and is compliant with the Web browser technology available today. Such a solution is small and light-weight yet scaleable and secure.

9.4 Intranet Access

In this approach, the Oracle WebForms interface will be used to front-end the Self Service solution. Custom designed forms based on Oracle*Forms technology can be generated with minimal development efforts through Designer 2000 and deployed over the Internet/Intranet. The generation capabilities in Designer 2000 are currently being used in many client engagements to generate Oracle*Forms front-ends in a client-server architecture. The generation techniques used in this option allows for immediate deployment of existing applications with minimal re-development efforts. The entire solution is based on proven Oracle products and is compliant with the Web browser technology available today.

9.5 PC/LAN Access

A system is currently under development by Oracle for use by Customer Service Representatives of the client. Oracle's Designer 2000 technology is being used in this project to generate Oracle*Forms front-ends and back-end business services in a client-server architecture. Also, as a part of the project the relevant business rules and models are being maintained in the Designer 2000 repository. The entire solution is based on proven Oracle products and the same architecture can be extended to the development of Self Service solutions.

9.6 IVR Interface

Currently, the client operates a simple IVR-based product information service for cellular customers. On a larger scale, the client has commenced work to pilot an IVR service to residential customers. The pilot will effectively add-on to the existing hardware and processes and will offer a limited set of services. The client is also developing an IVR/CTI solution concurrently for the Consumer and Business Fault Centres. All these solutions will be fully integrated into the Self Service environment. The IVR option will fully leverage the back-end services generated using the Oracle Designer 2000 repository.

10. Critical Success Factors

Based on IDC's review and analysis of the Web-based customer service and support market, the following observations are made regarding service providers that are currently employing, restructuring, or contemplating Web-based support initiatives.

10.1 Know Your Customer

The practice of knowing and understanding the needs and requirements of your customers is critical . The primary reason being that the "answer" may differ from service provider to service provider, product to product, and customer to customer. The needs of a home-based business having trouble with a particular communication service will be totally different from those of a Fortune 500 company.

Accordingly, the successful providers of Web-based services will seek to understand thoroughly the breadth of their customers' unique needs. Furthermore, the outstanding provider will anticipate them. Methods for achieving this understanding include:

- Talk to your customers at the time of a phone support incident. Create a process to make them aware of available Web support options, perhaps by talking them through a Web-based application.
- Conduct focus groups and surveys via Web-based forums. Offer incentives, such as product discounts, in exchange for participation and valuable comments.
- Place renewed emphasis on the "feedback" button on your support page.
- Embrace the emerging practice of customer profiling to individualise, personalise, and customise the user's experience with your Web-based support (ie. one-to-one marketing).
- Gather as much meaningful intelligence as possible from your site and use it to add value.

By thoroughly understanding what you are trying to achieve with your Web-based support (ie. who you are trying to satisfy and how), your efforts will be centred around the most important growth principle and should yield positive results.

10.2 Emphasise Your Strengths

As the business world continues to award survival, growth, and prosperity to highly focused organisations, renewed interest is being placed on the idea of concentrating on your "core competencies." This strategy is based upon realising where you provide the most value to your customers and concentrating your resources in that direction.

Instead of dealing with problems after they occur, focus on preventing them to begin with:

- Emphasise quality control. As product life cycles continue to collapse, substantial pressure is placed on service providers to add features and functionality rapidly, despite the potential to launch an unreliable product. By committing more resources to preventing problems, customer experiences with the product will be better, and "service provider induced" support calls may be reduced.
- Produce enhanced smart utilities. Diagnostic utilities, smart software, and automated help features possess the functionality to diagnose problems and assist in their repair at reduced levels of human or technical support involvement. These utilities will reduce both Web and phone-based support volume, providing service providers more time and human resources for creating value-added product.

Explore opportunities to collaborate with other parties that can add value to your Web-based support and vice versa. Potential arrangements could involve outsourced Web support site development and ongoing maintenance, data warehousing collection and analysis, and cross advertising and promotion via hot links with partners and affiliates. The common thread is that, in an increasingly specialised world, these activities may be better performed by specialised companies.

10.3 Keep It Simple

Although the technologies and systems underlying Web-based customer support may not be simple, the customer experience must be. The reason is that despite service provider hopes and dreams to "create" a more self-reliant customer, busy customers are reluctant to put much energy into finding solutions to their problems on their own if they find that solutions are not forthcoming and that substantial time and effort have been wasted.

A more realistic approach is to structure a balance between self help and human help from a customer service representative. This means building ease of use, responsiveness, and human interaction into the support tools and processes:

- Support wizards, which are smart software utilities designed to walk customers through a problem, step by step can be provided.
- All the successful companies on the Web, continue to innovate their offerings by launching a set of functionality, quickly listening to the needs of the their initial users and then responding with more target features. This is not the environment to plan a big bang functional system delivery in two years. This is the environment of interactive development and deployment.

- Over time, consumers will be drawn to online communities where a variety of their needs are met. Capturing this sense of community in all your self service activities is paramount.

The primary strategic benefit of such an approach is that it assists in removing the elements of frustration and fear in support situations by simplifying and humanising them, correspondingly strengthening the bond between customer and service provider.

11. Conclusions

All telecom carriers need to equip themselves to meet the challenges and customer needs in the radical new business environment in the emerging networked economy.

Web-based support represents an enormous opportunity for service providers to fulfil support services in the most efficient, effective, and personalised manner possible, while materially reducing the high support cost structures associated with personnel-intensive phone operations. The Web represents a unique sales and marketing channel and because of its bi-directional nature it can foster and build customer loyalty through engagement and response. The ability to remember customers' preferences and characteristics and to respond accordingly introduces an intimate quality into the nature of the relationship between the operator and the customer or dealer.

Web-based Self Help offers the prospect of a quality one-to-one relationship which puts the focus on maximising the share and value of each customer's business.

The challenge is to create a Web-based experience that is powerful, compelling and responsive for the customer

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China Telecom Deregulation: Market Realities and Future Trends

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Abstract

The telecom market in China has experienced tremendous growth in the last several years. However, the Chinese market still remains highly regulated and foreign companies are barred from provisioning telecom services. This paper provides an overview of the regulatory structure of the MPT, the new competitive environment and future prospects for telecom deregulation in China.

1. Introduction

The telecom market in China has experienced tremendous growth in the last several years with annual growth rates of over 40 percent since 1990. According the 9th Five-Year Plan (1996-2000), the Ministry of Posts and Telecommunications (MPT) will invest a total of US$60 billion during the five-year period before the end of this century in its posts and telecom infrastructure development. That translates into an annual spending of US$12 billion, and the majority of that investment is in telecommunications.

The large investment has brought about great increase in the telecom network capacity and telephone penetration rates. By the end of 1997, the public switched telephone network (PSTN) in China is expected to reach 115 million lines, ranking second in the world after the United States. Telephone penetration rates had reached 7.3 percent by August 1997 and is expected to reach 8 percent by year's end. The total length of fiber optic cables amounts to 820,000 km, of which 150,000 km are inter-provincial backbone trunks. When the project of the Lanzhou-Xining-Lhasa fiber optic trunk is completed in 1998, the fiber optic backbone network will reach all the provincial capitals and over 1,300 cities at and above the county level. Five international fiber optic links between China and Japan, the Republic of Korea and Russia have been completed. China has also participated in the construction of the China-US Cable, TAE, South Asia, SE-ME-WE 3 and FLAG fiber optic cable projects.

Another area of rapid growth is mobile and data communications. As of November 1997, China has more than 13 million cellular subscribers. The GSM network provides automatic roaming with 22 mobile networks in 18 countries and regions including France, Germany, Finland, Sweden, Switzerland, Italy, Spain, the Netherlands, Australia, Turkey, Indonesia and Singapore. The number of public data communications service subscribers has increased from 3,000 in 1993 to 300,000 as of July 1997. The Internet has also become the information highway linking China with the world.

One of the major reasons behind this rapid growth is the introduction of some degree of competition in China's telecom sector. The forming of the second telecom operator, China Unicom, is a major step in telecom deregulation in China. Even though China Unicom is much smaller in size and capability, its entry or the threat of entering into some markets, has prompted the MPT to take actions, sometimes unfairly, to compete for customers. The deregulation of value-added services such as paging and VSAT has led to fast growth of these markets as well.

Even though foreign telecom equipment vendors have reaped the benefits of the telecom growth by selling equipment, the telecom service market is still closed to foreign competition. The MPT has been able to finance the rapid growth by charging customers very high telephone installation fees and relying on domestically raised capital. With intensified competition from China Unicom and increased pressure from foreign companies and governments for greater liberalization, the MPT may have to allow greater participation of domestic and foreign companies in telecom services.

The following sections will focus on China's regulatory structure, the MPT, new competitive environment and prospects for further deregulation.

2. The Telecom Regulatory Structure and the MPT

China's telecommunications industry operates under a hierarchical structure with the State Council at the top, the commissions, ministries and provincial governments in the middle, and some 2,500 post and telecom administrations and enterprises at the provincial, municipal and county levels making up the base, with a division and overlapping of functions in policy, planning, manufacturing and services. The Ministry of Posts and Telecommunications (MPT) serves as the central pillar of this structure, with the authority from the State Council to oversee and manage the day-to-day workings of this sector.

The State Council is the highest organ of state administration. The State Council, the State Planning Commission (SPC) and the State Science and Technology Commission (SSTC) are in charge of general policy making. The National Five-Year Plans outline the goals to be achieved in telecommunications by the end of the plan. These plans are produced by the State Council in consultation with the SPC and the SSTC. On the other hand, the SPC asks the MPT for input in setting up the medium and long-term development objectives for the telecom industry. Once the objectives are set, the MPT devises annual plans to meet that goal. As part of that process, the MPT in turn sets goals for the provincial posts and telecommunications administrations (PTAs).

The Ministry of Posts and Telecommunications (MPT) is a functional department under the State Council governing China's posts and telecommunications industry. It is responsible for the macro control of the nation's posts and telecommunications industry, making overall plans, coordinating projects, and supervising operations. It exercises centralized control over the nation's public communications networks and markets.

The MPT has 12 departments at its Beijing headquarters. The following are the main departments:
Department of Policies and Laws, Department of Telecommunications Administration, Department of Planning and Construction, Department of Science and Technology, Department of External Affairs, and the Department of Finance.

The day-to-day management and provision of services are the responsibility of the Directorate General of Telecommunications (DGT) or China Telecom. DGT officially registered with the State Industry and Commerce Administration Bureau as an enterprise in mid-1995. This was a move in the process of separating the DGT as the operator of the nation's public telephone network from the MPT, the telecom regulator. Even though the DGT has moved out of the MPT compound at 13 West Changan Avenue to a new building in Beijing, its authority as the official national operator is still constrained at present. The national long distance network, including the three international gateways, are actually operated by provincial and municipality PTAs which hand their revenue directly to the MPT. The DGT does not own any telecommunications assets. The provincial PTAs report directly to the MPT. They are parallel administrative organizations with the DGT, not its subordinate operators. The long-term goal of the government to transform the MPT into an US FCC-type (Federal Communications Commission) regulator and the DGT into an AT&T-type operator will take time to realize.

Recently, the MPT has drawn a lot of criticism over its double role as the nation's telecom regulator and the de facto operator. Most complaints have come from China Unicom, the new second operator, especially before its gaining interconnection for its GSM networks with the MPT's networks. Unicom argues that the MPT cannot be an impartial judge when its own team is playing against others in the field. Unicom's argument was not without a reason. In fact, the MPT has allegedly tried to use various excuses not to interconnect Unicom's mobile networks with the MPT-controlled public telephone network until the State Council put pressures on the MPT for interconnection.

Even though the MPT is undoubtedly the most important player in China's telecommunications sector, the competitive scene is changing gradually in the last three years with the establishment of China Unicom and the entry of other competitive service providers such as Ji Tong Communications Company.

3. New Competitive Environment and China Unicom

In order to introduce competition in the telecom sector, the Chinese government approved the establishment of China Unicom as the second telecom operator. On July 19, 1994, with the approval of the State Council, China Unicom was officially established with the Ministry of Electronics Industry, the Ministry of Electric Power and the Ministry of Railways as the major shareholders. This was an important decision that marked the end of the near half a century monopoly that the MPT held in China's telecom industry .

Since its establishment, China Unicom has made some progress in providing telecom services, especially in mobile and paging communications. By October 1997, China Unicom had already started the construction of GSM mobile networks in over 100 cities with network capacity of more than 2 million users. Interconnection with MPT networks has been achieved and the Unicom GSM network has over 330,000 subscribers. China Unicom's paging network began wide area paging services in 10 cities in China in September 1996 and had 400,000 subscribers by October 1997. In addition, China Unicom has constructed tandem offices in over 37 cities for the provision of long distance services. Relying on the extra capacity of the dedicated networks for railways and power, China Unicom is installing long-distance backbone networks via fiber optic cables, microwaves and satellites. The local network projects are underway in Tianjin, Chongqing and Sichuan Province. The local network in Tianjin was put into trial operation on July 19, 1997.

As the only company in China with a mandate to compete with the MPT in offering telecom services, China Unicom has attracted a lot of interest from foreign companies and investors. Unicom has worked successfully together with Bell Canada International, Siemens of Germany, Mitsui of Japan, Sprint, France Telecom, Korea Telecom, Daewoo of Korea and STET of Italy. In the last two years, China Unicom has raised RMB9 billion (US$1.08 billion), 70 % of which is foreign capital.

The establishment of China Unicom has brought great changes to the domestic telecom market. Even though Unicom's network capacity and subscriber base are very small relative to the MPT's, competition has sped up telecom development, improved service quality and decreased prices. The consumers are the clear beneficiaries of market deregulation.

4. Prospect of Further Deregulation

Even though the introduction of limited competition in China's telecom market has generated undeniable benefits to the consumers, the MPT and the Chinese government have been so far reluctant to open the telecom service sector to foreign competition. One of the reasons given by the MPT for not allowing foreign investment in the telecom service sector is the current lack of a telecom law to guarantee fair competition. The ability of charging high installation and connection fees for both fixed and mobile phones by the MPT to finance network expansions has also led the MPT to believe that foreign participation in network operation is not necessary. However, both of these factors are changing.

The telecom law has been drafted and is believed to be released soon. The intensified competition between the MPT and China Unicom has led to continued decreases in prices, which is cutting into the MPT's profits and ability for self financing. In addition, China is bidding to join the World Trade Organization. On his visit to the United States in October, 1997, Chinese President Jiang Zemin has indicated that China will sign the International Technology Agreement. This will force China to further liberalize the telecom services market.

5. Conclusion

China has abolished the MPT monopoly in telecommunications by establishing the second carrier, China Unicom. Even though competition has been introduced in the telecom market, foreign companies are still not allowed to operate telecom networks in China. However, further deregulation in China's telecom sector may be coming soon because of the draft of the telecom law and the pressure from other countries on China.

Opening up Telecommunications in Sri Lanka - Will it Attract Investment and Reduce Waiting List ?

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1. ABSTRACT

Sri Lanka is one of the Asian countries with a low telecom penetration and a low growth rate up to very recent times. Government of Sri Lanka and the telecom regulatory authorities decided to allow many deregulatory measures such as licensing WLL operators and privatising the government owned Sri Lanka Telecom. Paper analyses the present scenario with regard to clearing the waiting lists and promoting telecom investments.

2. INTRODUCTION

At the end of 1996, Sri Lanka had a total of 254,500 main lines in service for a population of 18.5 million. This gave the country a main line teledensity of 1.39 per 100 population. In 1997, main lines are expected to grow by over 25% to 316,000.

Sri Lanka's latent demand for telephone lines, estimated to be over 500,000, has forced the government to introduce drastic measures to improve main line penetration. Since the 1990s, the Sri Lankan government has implemented several changes to do just this. This included the licensing of two new Wireless Local Loop (WLL) operators in February 1996 to compete against the incumbent operator, Sri Lanka Telecom Ltd. (SLTL), and the partial privatization of SLTL in which the Japanese carrier NTT bought over a 35% stake in the organization.

The newly licensed WLL operators are expected to jointly install a minimum of 200,000 lines in the country by the year 2000. Although main lines have grown by a compound annual growth rate (CAGR) of 109% between 1992 and 1996 (see Exhibit 1), it is still not enough to meet the country's huge waiting list. The growing waiting list is largely due to increasing per capita income (this grew by 17.5% between 1992-1996) arising from the growing number of Sri Lankans working overseas.

At the moment, all the districts and divisional secretariats, except for certain areas in the north and eastern regions (due to security reasons), are covered by SLTL's telephone network. However, more than 65% of total lines are currently concentrated in metropolitan Colombo(Exhibit 2).

SLTL plans to extend coverage to the villages during 1998.

Despite efforts to liberalize the data communications sector, only X.25 and X.28 packet switching and lease line services are available. However, the government's push to encourage the private sector to move away from traditional economies such as agriculture and into more economically viable sectors such as communications, transport, trade, and finance is expected to boost demand for faster and better data communications services. Although the government's main aim at the moment is to meet the demand for basic lines, it must look ahead to plan for future needs by ensuring that it leap frogs technology.

The lack of main lines coupled with the growing needs of the business community for Sri Lanka offers one of the most liberalized telecommunications markets in South Asia. As early as 1989, the private sector was already offering value added services such as cellular and paging.

3. REGULATORY ISSUES

Prior to 1980, the provision and regulation of postal and telecommunications services in Sri Lanka fell under the jurisdiction of the Post and Telecommunications Department (PTD). However, in 1980, PTD was split into two separate bodies — one for the provision of postal services and the other to operate the country's domestic and international telecommunications services. The Department of Telecommunications (DOT) was formed as a separate organization from the Post Office to operate the latter function. Both these organizations continued to report to the Minister of Posts and Telecommunications (MPT), which also played the role of regulator.

Exhibit 1

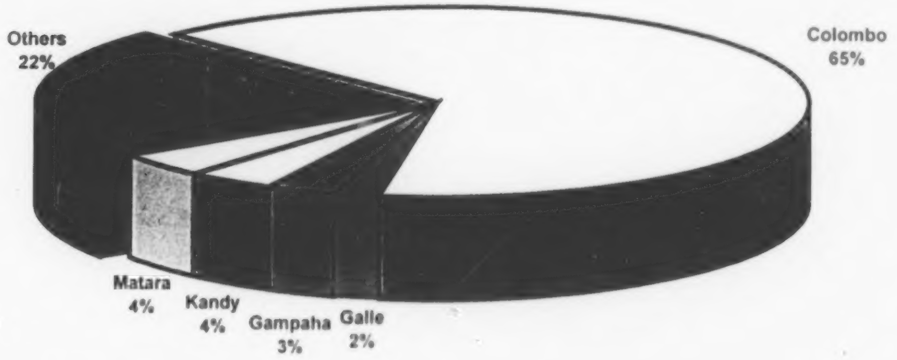
Sri Lanka - Population, Main Lines, and Teledensity, 1992-1997

	1992	1993	1994	1995	1996	1997
Pop (mn)	17.40	17.62	17.86	18.11	18.31	18.49
Main Lines (in'000s)	136	158	180	204	255	316
Teledensity	0.78	0.90	1.0	1.12	1.39	1.70
Annual Growth (%)	7.68	16.43	12.51	13.32	24.54	25.72

Source: Northern Business Information

Exhibit 2

Share of DELs in the SSC Areas, as at December 1996



Source: SLTL

Despite the restructuring, only limited improvements were made to the country's telecommunications infrastructure. To speed up the pace of telecommunications development, the Sri Lankan government appointed a committee to look into ways to deregulate the telecommunications market and instill competition. Thus, in July 1991, following the recommendations of a committee, the government passed the Sri Lanka Telecommunications Act No. 25.

This Act marked the second stage of reform in the country's telecommunications sector, bringing with it a number of important changes, including the creation of Sri Lanka Telecommunications Authority (SLTA) as the new regulatory body, and the corporatisation of the DOT to create Sri Lanka Telecom (SLT).

Further changes were announced in 1996. A new regulatory body, the Telecom Regulatory Commission of Sri Lanka (TRCSL), was formed under the Sri Lanka Telecommunications (amendment) Act No. 27.

3(a) Current Telecom Regulations

There are presently two laws governing the telecommunications services market in Sri Lanka. They are the Telecommunications Act No. 25 of 1991 and the Telecommunications (Amendment) Act No. 27 of 1996. Together, these two Acts provide the basis of a legal framework for a dynamic and competitive telecommunications industry.

The Sri Lanka Telecommunications Act No. 25 of 1991 is divided into seven parts and provides for (i) the appointment of a Director General of Telecommunications; (ii) the transfer of all property rights and liabilities of the Department of Telecommunications to the Corporation named "Sri Lanka Telecom" established by order under Section 2 of the State Industrial Corporations Act No.49 of 1957; (iii) the repeal of the Telecommunications Ordinance (Chapter 192); and (iv) matters connected therewith or incidental thereto.

Under this Act SLTA was formed as the regulatory body and Sri Lanka Telecom Corporation was created to absorb the operations of SLTD which was a government department prior to 1991.

The Telecommunications (amendment) Act 27 of 1996 was an amendment to the original Act No. 25 of 1991. This Act established the Telecommunications Regulatory Commission of Sri Lanka (TRCSL) in place of the appointment of a Director-General of Telecommunications where the original one man commission was replaced by a five member commission. Under this Act, the Secretary to the Ministry becomes the Chairman of the Commission, while the former Director-General becomes the Chief Executive Officer of the TRCSL.

The amendment also allowed the former SLTA to be converted to an independent commission where it could be governed and managed as an independent corporate body with operational flexibility.

3(b) Competition

TRCSL is actively promoting competition by adopting transparent procedures in licensing operators, facilitating fair and reasonable interconnection, promoting economically sound cost-based pricing principles and providing adequate regulatory certainty to investors. The number of competitors and duration of their licenses is determined by market and economic factors, subject to the availability of resources such as radio frequency.

At the moment, the only area in which a monopoly is retained by SLTL is in international telephony service. However, this segment of the market will be liberalized by August 2002. TRCSL is expected to restrict the number of international operators to two, including SLTL. The new operator will be given a five year license.

Exhibit 3 lists all licensed telecommunications operators in Sri Lanka as at August 1997.

3(c) Telecommunications Development Plan

In an effort to quickly increase the growing demand for basic services, the government of Sri Lanka formulated a short-term telecommunications development plan in 1988. The plan was formed with the support of the Asian Development Bank. Although the target of the plan was to increase switching capacity to 500,000 lines by 1995, this was never met. Several of the projects under this plan are still on-going.

The development projects, which has gained much financial support from donor agencies and foreign governments, can be divided into two groups - the foreign funded projects and those funded internally. Countries that have been instrumental in supporting SLTL's development projects are the governments of Japan, France, Finland, and Norway.

One of the most publicised telecommunications development projects launched by the government during the 1990s is the 150K Project (initially 100,000 lines were to be installed but this was later expanded to 150,000, and finally adjusted to 230,000 by 1998). A new organization, Sri Lanka Telecom Services Company Ltd. (SLTS), was also formed by the government in April 1993 to oversee this project.

Initially, SLTS was to act as an independent operator after the commissioning of the project. However, in the long run, it is unlikely that the company will become a licensed operator. Instead, SLTS may become a subcontractor for SLTL for consulting services.

A see-saw of events occurred between 1993-1996 which very nearly resulted in the project being canceled. This included the nearing of the country's general elections and heavy opposition from the trade unions who were threatened by the formation of SLTS. These were just some of the reasons which led to the suspension of the project in 1994. A committee was then formed to look into the problems created by the project. At this stage, one of the successful bidders for the Colombo/Vavuniya areas, AT&T, pulled out of the contract. A new tender was then put out for the two areas. After evaluating the bids for two years, Mitsui and the LG Group were awarded the contract for Colombo while Ericsson won the Vavuniya contract. The delays in the project eventually saw the original 100,000 line project grow into a 230,000 line project. Full details of the project is given in Exhibit 4.

4. CURRENT OPERATORS AND THEIR SERVICES

Sri Lanka, like many of its South Asian neighbours, suffers from extremely low main line penetration levels. At the end of 1996, the country only had 254,500 main lines for a population of over 18 million. In contrast Malaysia, which houses a population of about 19 million, enjoys a penetration of 18.4 per 100 population.

There are currently 25 licensed telecommunications service providers in Sri Lanka. Out of these, 23 are in the general telecom service business while the remaining two operators, namely Air Lanka and SITA, operate their own private networks.

At the moment including SLTL, there are three domestic basic, four cellular, five paging, one trunk radio, six data transmission, four public pay phone, six internet, one premium services, and two store-and-forward fax service operators licensed in the country. SLTL still holds a monopoly in international telecommunications services. TRCSL has indicated that it plans to liberalize this market by August 2002 with one additional operator.

The government licensed two additional wireless local loop (WLL) operators in February 1996 in an effort to help push the development of basic services in the country. The new operators, Suntel and Lanka Bell, are required to install a total of 200,000 lines by the year 2000. Both are, however, confident of surpassing this number.

Exhibit 3

Licensed Telecom Operators in Sri Lanka (August 1997)

Operator	Date of License	Duration	Services
Sri Lanka Telecom Ltd	Aug 1991	20 years	Basic domestic & intl telephony, telegraph & telex, data transmission, maritime mobile, facsimile, intl TV transmission, voice cast transmission, IDS, INMARSAT.
Lanka Communication Services (Pvt) Ltd	July 1991	20 years	Switched & non-switched data comms, store & forward fax, e-mail, video text, enhanced voice.
Electroteks (Pvt) Ltd	Nov 1991	20 years	Switched & non-switched data comms, telex, directory info, store & forward fax, e-mail, video text, enhanced voice, EDI, database facilities.
SITA	Aug 1992	5 years	Switched & non-switched data comms, telex, e-mail, data processing within airline industry, SITAFAX.
Infocom Lanka Ltd	Sept 1992	10 years	radio paging
Bell Communication Lanka (Pvt) Ltd	Dec 1992	10 years	radio paging
Telstra	Feb 1993	7 years	cellular mobile
Fentons Ltd	Feb 1993	10 years	radio paging
Dynacom Engineering (Pvt) Ltd	Feb 1993	5 years	trunk mobile radio
Intercity Paging Services (Pvt) Ltd	April 1993	10 years	radio paging
Equipment Trades Ltd	Sept 1993	10 years	radio paging
MTN Networks (Pvt) Ltd	Sept 1993	20 years	cellular mobile
Air Lanka Ltd	Dec 1994	5 years	Voice and data communications for Air Lanka's internal use only
Lanka Internet Service Ltd	Dec 1994	20 years	E-mail, internet, store & forward fax, e-mail to fax & fax to e-mail, telex, X.25 data transmission, video conferencing, enhanced voice services
The Payphone Co (Pvt) Ltd	Dec 1994	10 years	Public payphone
MTT Network (Pvt) Ltd	May 1995	20 years	Lease circuits
Celltel Lanka Ltd	Sept 1995	13 years	cellular mobile, voice mail, fax, lease excess WLL capacity to payphone operators
CeyCom Global Communications Ltd	Sept 1995	20 years	Switched & non-switched data communications
Telia Lanka (Pvt) Ltd	Feb 1996	20 years	Fixed basic telephony, data transmission, public payphone, voice mail, facsimile
Lanka Bell (Pvt) Ltd	Feb 1996	20 years	Fixed basic telephony, data transmission, public payphone, voice mail, facsimile
Itmin Ltd	June 1996	20 years	Switched & non-switched data communications
Eureka Online (Pvt) Ltd	Aug 1996	10 years	Switched & non-switched data communications
Pan Lanka Networking (Pvt) Ltd	Apr 1997	10 years	Internet
Milleneum Technologies	Aug 1997	N.A.	Premium services

Source: TRCSL

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Exhibit 4

Details of 150K Project

Contractor	No of Lines	Service Areas	Value (in US$ mil)	Expected Date of Completion
Korea Telecom	4,650	Trincomalee	8	completed
Ericsson	64,298	Kalutara, Kurunegala, Kandy, Gampaha, Matale, Batticaloa, Kalmunei, Ampara	70	Dec '97
Mitsui	21,694	Negombo, Kegalle, Pollonnaruwa	30	Nov '97
Nokia & NKF	15,420	Chillaw, Hambantota	14	Nov '97
Motorola	6,992	Kandy, Kalutara, Galle, Nuwara Eliya	7	Aug '97
Sumitomo	46,981	Anuradhapura, Badulla, Bandarawela, Galle, Nuwara Eliya, Ratnapura	36	Dec '97
Mitsui/LG	67,750	Colombo	30	Dec '98
Ericsson	2,500	Vavuniya	4	Dec '98
Total	**230,285**		**199**	

Source: SLTL

Though SLTL boasts of a 95% digital switching network, its range of enhanced services are few and do not support the growingly sophisticated needs of the business community. SLTL's ratio of subscribers in the Colombo area is 54% residential, 38% business, and 8% government. In the outskirts, the ratio is 51:35:14. Despite claims of providing nationwide coverage, SLTL's distribution of main lines is uneven between the Colombo metropolitan and other regions. There are plans to introduce the ISDN service, although this will not take place until 2000.

Both the WLL operators have launched their services, although largely in the Colombo district. As line deployment increases, their services will spread to the other parts of the island. Suntel launched its service in February 1996 and had about 14,000 subscribers at the end of August 1997. The company's transmission network is based on equipment supplied by Ericsson (DRA-1900 radio access system). Lanka Bell started offering its services in March 1997. At the end of August 1997, the company had approximately 8,000 subscribers. Lanka Bell's transmission equipment is supplied by Nortel.

4(a) Mobile Communications

Sri Lanka's mobile communications market comprises of the cellular, paging, and trunk radio services. There are currently four cellular, five paging, and one trunk radio operators.

Cellular mobile, which was first introduced in 1989, is the most competitive telecom service market in Sri Lanka at the moment. There are currently four operators offering a combination of analog and digital networks. All four companies providing the service were incorporated under partnerships between local and foreign companies. However, as at August 1997 only one, Mobitel, remains a joint venture between SLTL and Telstra. The remaining three operators (Celltel Lanka, Lanka Cellular, and MTN Networks) are run by foreign concerns.

At the end of 1996, there were a total of 66,245 cellular subscribers for all four networks. The limited availability of radio spectrum (which requires strict defense clearance) coupled with the already competitive market is unlikely to see the government issuing more licenses in the near future. The take-up of the cellular mobile service is still considered low given the long land line waiting list and the ratio of cellular subscribers against total population. Some important reasons for this include the low income level of the population which does not allow the average person to purchase a cellular phone, high call rates, and limited geographical coverage.

The paging service was first launched in 1981 by a private operator, Equipment Trades. There are now five operators and at the end of 1996, there were only a total of 9,260 subscribers. The paging service suffers from slower growth than the cellular service. Lack of geographical coverage, innovative services, and low public payphone penetration levels are some of the reasons for the dismal performance of the service.

4(b) Data Communications

Data communications services are still in the infant stages in Sri Lanka although the market has been liberalized since 1991. There are currently eight licensed data communications service providers, including SLTL. As late as 1991, SLTL was only offering leased lines. Due to the high cost of lease lines, many potential subscribers turned to private operators who had introduced other forms of datacom services, such as packet switching, to fulfill their needs. The major datacom players currently are SLTL, Lanka Communications Services, Electrotek Networks, and Lanka Internet.

At the end of 1996, the packet switching service had a total of 144 subscribers. The service has been slow to take off. Sri Lanka's business community is currently largely made up of low technology, high manpower industries such as garment manufacturing and agriculture. Although there are business segments with high requirements for data communications services such as those in the shipping, freight forwarding, and tourism industries, these are few in number. Small to medium-sized companies, who would ordinarily be one of the target groups of the datacom providers, usually do not have the funds to subscribe to the service. Late entry of the service into the market, coupled with the lack of aggressive marketing on the part of the operators are also other factors affecting growth. Most of the operators are currently targeting the service to corporate customers explaining the low subscriber base.

Lease lines are currently provided by four operators, including SLTL. The growth in internet subscribers has created a market for lease lines. At the end of 1996, there were a total of 2,497 domestic and international lease line subscribers. The sudden jump in domestic lease line subscribers in 1996 was due to the high demand for lease lines from the banking sector which started to promote new services such as phone banking. Lease lines were needed to network the banks' branches around the island.

The internet service was only introduced in Sri Lanka in 1995. There are currently seven (including SLTL) licensed internet service providers (ISPs) and one government operator in the country. At the end of 1996, Lanka Internet had the largest subscriber base of over 2,500. NBI does not project a high growth rate for the service largely because PC ownership is still out of range for the majority of the population. However, the emergence of internet cafes in the country will certainly help spread the popularity of the service.

5. CONCLUSION

The government's decision to open the country's telecommunications sector will certainly benefit it in the long run. History has shown that restructuring the regulatory and operating agencies and maintaining a monopoly environment has done little to help improve telecommunications development. The country's two new domestic basic services operators will certainly help the struggling incumbent operator in reducing the growing waiting list. In addition, SLTL's strategic move to embrace NTT as a minority partner will no doubt help the company in improving both its service quality and quicken main line deployment. With the above measures in place, the government hopes to clear the waiting list for telephone lines by 2015.

This paper is a summary of a 150 page report on "Telecoms in Sri Lanka An Industry and Market Analysis" researched and written by the authors in September 1997. The said report is based on proprietary information gathered by the authors for the study. Northern Business Information, a division of the Gartner Group, is a leading telecom research firm which conducts proprietary research and produces a full range of telecommunications reports.

References:

1. A D V N Kularatna, Sakina Dhilawala; "Telecoms in Sri Lanka An Industry and Market Analysis", Northern Business Information, Sept 1997.
2. A D V N Kularatna, Gamini Gunawardena and Chandana Williams; "Value Added Services & Private Sector Investment in New Telecom Projects in Sri Lanka", proceedings of the 17th Annual Pacific Telecommunications Council conference, PTC '95, pages 442-444.
3. ADVN Kularatna; "Contribution by the Operators of Private Telecommunications Services Towards Development of Telecommunications Infrastructure of Sri Lanka in the Recent Past", proceedings of the 16th Annual Pacific Telecommunications Council, PTC'94, pages 415-420.

PT. TELKOM Indonesia: the Development and Deregulation of the National Telecommunications Sector

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1. ABSTRACT

This paper will describe a general view of telecommunications infrastructure development trend and telecommunications industry structure in Indonesia after the deregulation of telecommunications sector which has been enacted by the government in 1989. This paper also examines the strategy taken by PT. TELKOM, as the incumbent domestic operator in anticipation to the future challenges and opportunities in the telecommunications business

2. DEREGULATION FRAMEWORK

Enacted in 1989, Telecommunications Law 3/1989 is the principal telecommunications statute in Indonesia and, along with the rules, regulations and decrees promulgated thereunder, establishes the legal framework for regulation of the telecommunications sector. The primary purpose of the Telecommunications Law is to open the sector to limited private sector participation under the aegis of designated state-owned telecommunications companies "organizing bodies" which have been delegated the authority and responsibility both to organize and provide telecommunications services and infrastructure. Telecommunications services provided by these organizing bodies are separated into two classes, basic and non-basic. Under this classification, private companies may offer basic telecommunications services, but only in cooperation with an organizing body and pursuant to a license from the MTPT. The Telecommunications Law permits such cooperation in basic telecommunications services only in the form of

a) joint venture companies in which the organizing body has a direct or indirect equity participation,
b) joint operating schemes (such as PBHs and KSOs) and
c) management contracts.

By contrast, the private sector may provide non-basic services without the cooperation of an organizing body, although a license from the MTPT must still be obtained.

By MTPT Decree 61/1995, the MTPT confirmed that TELKOM is and will remain an organizing body for domestic telecommunications services for so long as TELKOM exists. "Basic services" generally involve the delivery of information between sender and receiver without processing or modification, including voice and data telephony, telex, telegraph, leased lines and packet switched data. "Non-basic services" generally involve the delivery of data which has been processed or modified by computers or otherwise. Such services include electronic mail, paging, store and forward facsimile and abbreviated dialing.

As an organizing body, TELKOM is not required to hold a license in order to provide telecommunications services, other than licenses allocating frequency bands. Joint operating schemes, such as PBHs and KSOs, also do not require licenses to provide telecommunications services as TELKOM remains the operator of the businesses. joint venture companies, however, do require licenses, procedures for which are contained in MTPT Decree 39/1993 for basic services and MTPT Decree 116/1991 for non-basic services. MTPT Decree 39/1993 provides that the MTPT may issue licenses to TELKOM joint venture companies in which TELKOM has a direct or indirect interest for the provision of basic services based on certain criteria, including the estimated need within a community for new telephone lines for the next ten years and the call completion ratio within that region. Each year, the MTPT determines the locations for such services, taking into account proposals of the TELKOM joint venture company seeking to provide such services. Private entities seeking such licenses must make an application to the MTPT to demonstrate their operational and financial capability. The MTPT initially issues a license in principle allowing the joint venture company to prepare its operations, culminating in the issuance of a license to operate once the MTPT deems the venture ready to offer its services to the public.

Private entities are not required to cooperate with TELKOM to provide non-basic services, however they must obtain a license from the MTPT. The procedures for obtaining a license to provide non-basic services, as set forth in MTPT Decree 116/1991, are similar to those contained in MTPT Decree 39/1993.

2.1 Exclusivity

Pursuant to MTPT Decree 61/1995, the MTPT confirmed that TELKOM is and will remain an organizing body for domestic telecommunications services under the Telecommunications Law. In addition, with effect from January 1, 1996, MTPT Decree 60/1995 grants to TELKOM (i) the exclusive right to provide local fixed wireline and fixed wireless telecommunications services nationwide, including services provided for and on behalf of TELKOM pursuant to joint operating schemes, for a minimum of 15 years and (ii) the exclusive right to provide domestic long distance telecommunications services for a minimum of ten years. These decrees effectively preclude the MTPT, without abrogating the rights of TELKOM under these decrees, from granting another entity the status of organizing body for the provision of domestic telecommunications services. TELKOM believes that its grant of exclusivity in the provision of local and domestic long distance fixed wireline and fixed wireless telecommunications services is subject to other licenses in existence as of January 1, 1996, although the decree is silent on this subject.

These decrees, however, are subject to the MTPT's authority to regulate competition in the industry. Under the Telecommunications Law, other operators are permitted to offer basic telecommunications services provided that they do so in conjunction with TELKOM, either pursuant to a joint venture, a joint operating scheme or a management contract. The MTPT has sole authority to license or approve joint ventures in which TELKOM has a direct or indirect equity interest or joint operating schemes with TELKOM, and TELKOM's consent is not required to be obtained in connection with the grant of any such license or approval.

3. CURRENT INDUSTRY STRUCTURE FOR DOMESTIC SERVICES

TELKOM is the primary provider of telephone services in Indonesia. It owns and operates the country's only public switched telecommunications network. TELKOM is also the organizing body for domestic telecommunication services; no other entity may provide basic domestic telecommunication services in Indonesia unless it does so in direct or indirect cooperation with TELKOM.

With effect from January 1, 1996, the MTPT has granted TELKOM (I) the exclusive right to provide local fixed wireline and fixed wireless telecommunication services nationwide, including services provided for and on behalf of TELKOM pursuant to joint operating schemes, for a minimum of 15 years, and (ii) the exclusive right to provide domestic long distance telecommunication services nationwide for a minimum of 10 years.

Most telecoms operators interconnect with the company's network in order to provide comprehensive service. For example mobile cellular calls usually originate on, terminate on, or transit through the Company's network. Moreover, TELKOM participates in each business offering basic services either as a shareholder in a joint venture company or as a participant in a joint operating scheme. Such joint venture companies offering basic services include mobile cellular operators and one fixed wireless operator.

3.1 Partnership Arrangements and joint Ventures

TELKOM has entered into a variety of arrangements with private investors to finance the construction of network infrastructure, to provide specialised services and to diversify its operations. Private participation in basic domestic telecommunications services with TELKOM can take the form of (i) joint venture companies, (ii) joint operating schemes and (iii) management contracts. To date, TELKOM has not entered into any management contracts. joint operating schemes are in the form of revenue sharing arrangements called "PBHs" and operating arrangements called "KSOs."

3.2 PBHs

PBHs, or revenue-sharing arrangements, with private investors for projects such as the

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installation of fixed wirelines, the provision of analog mobile services and the production and maintenance of card payphones. PBHs were introduced to complement the expansion plans of the Company. These revenue sharing arrangements were used primarily to finance the expansion of the fixed wireline network and to launch the country's mobile cellular service. In a PBH arrangement, the private investor generally finances and builds a given project and upon completion receives a percentage of the revenues generated from the project either for a fixed term or until such time as the private investor's agreed return on investment has been attained. The private investor retains legal ownership of the constructed assets until the expiration of the PBH arrangement whereupon ownership is transferred to TELKOM. During the term of the PBH, TELKOM is responsible for the operation of the project and bears all operating expenses associated with PBH lines.

PBHs with respect to telecommunications services do not require operational licenses. However, the PBH investor must (i) be in the business of the provision of telecommunications services and have sufficient financial resources and professional personnel, (ii) demonstrate the operational worthiness of its plan, (iii) obtain the MTPT's approval, (iv) in the case of PBHs lasting less than one year, obtain the approval of TELKOM's Board of Commissioners and (v) in the case of PBHs lasting more than one year, obtain the approval of TELKOM's shareholders.

3.3 KSOs

The KSO Agreements provide for a form of contractual joint venture agreement under which the KSO Investor, through the KSO Unit, will be responsible for the operation of the local network of the KSO Division. A different KSO Unit, each involving a separate international telecommunications operator, will operate each KSO Division. The Company believes that dividing the country into geographic regions and contracting with separate KSO Investors to develop and operate each KSO Division is the most advantageous means of carrying out the development and operation of those Divisions given the magnitude of the planned line development, the difficulty of the line development given the terrain and the geography of the country and the scope of the required financial, managerial and other resources. The Company also believes that having a different major international communications operator involved in each KSO Division is preferable to having one such operator for all five KSO Divisions because the Company should benefit from the potentially different managerial, operational and technical strengths of all five such operators as opposed to just one. In addition, the Company believes that the KSO structure offers a combination of flexibility and effectiveness in achieving its objectives for development and improvement of the Network and meeting the Government's goals in Repelita VI. The following table indicates installed lines to be constructed by the KSO investors:

Region	Lines to built	Partners
Sumatra	500.000	France Telecom/ Astra
West Java	500.000	US West/ Aria West
Central Java	400.000	Telstra and NTT/ Indosat
Kalimantan	237.000	Cable & Wireless/ TMM
East Indonesia	403.000	Sing-Telecom/ Bukaka

3.4 Joint Venture Companies

Currently, Joint Venture Companies in Indonesia are mostly cellular mobile phones operators as the cellular mobile phones have become increasingly popular, and people from all walks of life and professions are using them as an alternative to the in adequate fixed line telephone. Since 1994, the Indonesian government has licensed the following companies to provide telecommunications-related business:

TELCO'S (JVC)	BUSINESS
TELKOMSEL	• GSM Mobile cellular
SATELINDO	• International telecommunication carrier • GSM mobile cellular • Satelit transponder leasing
RATELINDO	• Fixed cellular
TELEKOMINDO	• AMPS analog cellular PBH • Fixed wireline PBH • GSM mobile cellular

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KOMSELINDO	• AMPS analog cellular
LINTASARTA	• Data communication • Fixed wireline PBH • Credit Card payphone PBH
PASIFIK SATELIT	• Satellite transponder leasing
EXELCOMINDO	• GSM Mobile cellular
OTHERS	• AMPS cellular • VSAT • Voice mail • Directories • Others.

4. DEVELOPMENT OF THE DOMESTIC TELECOMMUNICATIONS NETWORK

The Government's development policies, of which its long term domestic telecommunications plans are a part, are set forth in consecutive five-year plans known as "Repelitas". Each repelita assesses the current level of economic progress, establishes priorities for the next five-year plan and realigns those previously made for future Repelitas. To date, Indonesia has completed 5 repelitas. The current repelita VI ends on March 31,1999. In Repelita VI, the government's general goals for the domestic telecommunications sector are to increase the accessibility, affordability and quality of telecommunications services in Indonesia.

The following table shows the targets for local exchange capacity, and local exchange capacity per 100 inhabitants for each of Repelitas VI through X.

Development Targets	Repelita				
	VI	VII	VIII	IX	X
	(Year Ended March 31)				
	('99)	('04)	('09)	('14)	('19)
Local exchange capacity (millions of lines)	10.5	19.0	29.0	42.0	60.7
Local exchange capacity per 100 inhabitants (line penetration)	5.1	8.7	12.4	17.1	23.6

To facilitate achievement of the goals of Repelita VI, the MTPT and TELKOM have encouraged the participation of the private sector and the introduction of the capital through the introduction of joint venture companies and joint operating schemes including PBHs and, more recently, the KSOs

5. TELKOM's BUSINESS STRATEGY

TELKOM has adapted business strategy designed to maintain the company's growth while achieving the government's target for the telecommunications sector. The following discussion highlight the principal components of TELKOM's business strategy.

5.1 Expand and modernize the Network

TELKOM plans to expand its revenue generating lines in service by aggressively installing and connecting new lines, improving capacity utilization and enhancing overall network performance. The Company plans to construct minimum of 3.15 million installed lines in Division II (Jakarta) and Division V (East Java) during five-year period ended December 31, 1998. In the KSO divisions, TELKOM expects approximately two million additional installed lines to be constructed by the KSO Investor between January 1, 1996 and March 31, 1999. In addition, TELKOM expects to complete construction of 1.4 million installed lines in the KSO Divisions by December 31, 1998. TELKOM is in the process of increasing capacity utilization through the accelerated construction of additional outside plant, implementation of certain fixed wireless, access technologies, targeting and developing areas of high demand, and the roll-out of certain marketing and promotional programs expected to encourage subscriber connection.

5.2 Promote increased revenue per subscriber line

The Company plans to increase average revenues per line in service by providing certain value-added services, increasing the number of business lines in service and by promoting increased usage of existing service through marketing and pricing programs as well as by improving service quality and availability. The Company is supporting this strategy by investing in high performance, high quality digital overlay network in areas with concentrated business subscribers with service requirements beyond that currently available.

5.3 Improve organizational and managerial efficiency

To achieves levels of operating efficiency in line with those operators of more developed countries, TELKOM has recently implemented a Restructuring program to streamline central management, consolidate operations, introduce new management control and planning systems and upgrade the quality of its staff. The Company also to expects the transfer of managerial, operational and technical expertise from the international telecommunications operators participating in the KSOs. In addition, the introduction of experienced operators in the KSO Division will permit TELKOM to focus management's time and resources on Division II (Jakarta) and V (East Java) and the Network Service Management.

5.4 Enhance customer service and marketing

The Company has introduced a number of marketing initiatives to stimulate demand and has established a customer surveys to obtain feedback on customer satisfaction and the demand for new and existing services.

5.5 Identify and exploit new business opportunities

TELKOM continually assesses new technologies and services and seeks to identify business opportunities related to their commercial application. As part of this policy, the Company is positioning itself as a future provider of multimedia services by digitalising the Network, replacing copper wire with optical fiber and introducing broadband technologies among selected high-volume business users. The Company believes that its deployment of optical fiber will serve the enhance its competitive position against other provider of alternate delivery systems for this services. TELKOM is also undertaking a pilot PCN project, which, if successful, will lead the Company to seek appropriate licenses.

6. CONCLUSION

The Indonesian market for telecommunications services is still huge due to the growing size of the middle class and relatively high economic growth. This would obviously be very attracting for the private sector to participate in the telecommunication business.

Indonesia undertakes its deregulatory measures in a unique way by inviting the private sector to participate in providing basic telecommunication services in cooperation with TELKOM as the organizing body in the domestic telecommunications services.

Electronic Delivery Systems In Instruction

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1. ABSTRACT

This paper examines the different potential electronic delivery systems currently available and their implications to the different components of the instructional system.

2. INTRODUCTION

In the past, instruction was offered by the teachers to the students, by a variety of means such as class room teaching, individual coaching, apprenticeship training, laboratory training, etc. In this process of teaching, the teacher was assisted by variety of media/teaching aids such as chalk board, magnetic board, films, slides, transparencies, books, video programmes, computers. As we observe the process of change, we find a definite transition to electronic media and associated delivery mechanisms. These electronic delivery mechanisms are not simple changes in the format/media in the instructional delivery but represent a qualitative change with ramifications to the teacher preparation, preparation of instructional materials, the very process of education, the institution of organized school and to the carefully built learning theories. This paper examines the different potential electronic delivery systems currently available and their implications to the different components of the instructional system.

We may restrict the scope of the instructional delivery system with a definition to enable us to discuss the various issues within the boundaries of the definition. This definition is specially given for this article.

Instructional delivery system is a conceptual framework where the components of the framework act together to communicate the knowledge, skills and attitudes to the recipient in a systematic manner in order to achieve a set of (predefined) objectives.

In this definition the components of the frame work may encompass all the entities of , a classical school system such as teachers, class rooms, laboratories, workshops, administration, the resources such as books, library, and other instructional materials, and the recipients which includes full time students, part-time students, industrial workers on continuing education programmes organized either at industry or in the institutions, and the students of distance education programmes.

It may be useful to categorize the delivery systems encompassed by the above broad definition into some classification scheme. The scheme based on the time and place of the learner and the teacher (1) is a useful one as it provides grouping of the instructional delivery systems to suit specific situations. The classification scheme is given in table 1.

TABLE - 1

		Place	
		Same	Different
Time	Same	Lecture/conference, laboraotory, Fax, telephone 1	Broadcast TV,TV, Audio conferencing, Video conferencing 3
	Different	Library, laboratory, CAL, ITS, Cable, TV, Computer integrated lab 2	CAL,ITS,CD-1, Computer Networks, Simulation Lab Video films 4

3. ELECTRONIC DELIVERY SYSTEMS-TECHNOLOGIES

The Electronic delivery systems offer a wide range of options to the schools, teachers and learners. Often, the quality of learning experiences provided by the electronic delivery systems is much more enriching than the conventional systems. However the introduction or the use of these delivery systems needs careful evaluation of the following parameters for better and cost effective impact:

- Target group size,
- Academic level (age),
- Geographical distribution,
- Geographical accessibility,
- Communications infrastructure,
- Target group availability,
- Discipline of study,
- Educational infrastructure (Trained teachers, Availability/Production of Instructional materials, H/W and S/W usage and Maintenance)
- Motivation and receptivity to NTT,
- Costs-capital, running, I.M. preparation and distribution.

We may look at some of the delivery systems with brief explanation and comments. The list is neither exhaustive nor standardized. It is also not presented in any particular order. Some of the delivery systems with which we are well familiar with are simply named and no explanation is offered. Some of the technologies that are in existence over a long period but whose potential in education are not exploited are briefly commented upon. Since most of the media/delivery systems can be used in the conventional Instructional systems, the aspects that are relevant to non-conventional delivery modes are emphasized in this discussion.

3.1 RADIO

3.1.1 TELEPHONE

Telephone can be used for large group teaching with the help of amplifiers. Since most places are connected by telephone, it is possible to make use of this facility for instructional delivery. The long distance telephone charges may be prohibitively high in most cases. Two Telephone connections provides bi-directional audio link. No further infrastructure is needed to utilize this technology.

3.1.2. FAX

Fax offers communication using text and Graphics. Since fax messages received on computer can be projected through projection systems, and since fax can be 'instantaneous', it provides a very good interactive link between the teacher and the taught. The taught could be an individual or a group in a class room. The fax mode was utilized in Australia to deliver instruction at remote locations with the help of a semi skilled teacher. The only requirement is a good telephone line and a fax machine (not required if scanner is attached to computer) and computer. It is comparatively less expensive than telephone.

3.1.3. AUDIO CONFERENCING

In the Audio conferencing with voice only a small group or the whole class can interact with the teacher in 'Voice' mode. Audio conferencing in Graphic mode allows voice communication along with the information on the electronic board. At the teachers' location electronic board is required. Audio conferencing with low quality/compressed video is possible on the telephone lines. The student to teacher link remains voice mode in most of these variations. The costs are determined by the telephone charges.

3.1.4. AUDIO TEXT

Audio text allows us to integrate a data base with voice interface between the human and the database. It is common in most voice assisted enquiry response systems. It has yet to find its applications in education. It uses text to voice conversion facility.

3.2. VIDEO FILMS

3.2.1 BROADCAST TV

Video disc, under computer control offers the facilities of interactive video. It could be used by individuals for self studying and by teachers for group teaching as in the class room. With its capacity for near perfect still frame to full speed and full screen video and with an average retrieval speed of 15 s from more than 100,000 frames, it provides a good and inexpensive instructional delivery system.(1-4)

3.2.2. CABLE TV

Most of us have experienced this technology and the power of cable TV. Since the investment in cable TV is already existing. Can this infrastructure be used for educational purposes? The incremental cost for such a conversion is more from the point of organizing the educational programmes for viewing. It is possible to combine such systems with live lectures for the individuals participating from their homes or participating from the remote class rooms. It is possible to address issues such as Continuing education (CE) for adult literacy and CE for industrial workers using this delivery system. (1-4)

3.2.3. INTERACTIVE TV

A number of experiments were conducted using satellite TV for Instruction. The students can view the live lectures broadcast through satellite. However the students can communicate with the teacher using an audio or video uplink from the school to satellite. The mobile units providing the uplink to satellite tend to be expensive.

3.2.4. VIDEO CONFERENCING

The digital compression Video conferencing systems can in principle, provides a fairly good connectivity between sites situated at different locations with full motion and full screen capabilities with near TV quality visual effect. The professional quality Codecs and Decodecs are expensive. For small groups, desk top video conferencing systems offer inexpensive solutions.

A word of caution regarding the conferencing or remote lecturing situations is needed. Since the technology does not restrict the number of participating audience, we may be tempted to reach larger groups of audiences. It is not the technology, but the interaction capabilities of human teachers that will impose restrictions on the number of students.

3.3. CAI : COMPUTER ASSISTED INSTRUCTION

Computer Assisted Instruction or Learning that originated from Programmed Instruction has undergone a variety of changes. It offers a very powerful instructional delivery system that is relevant to individual student, small groups and for classroom teaching. With its current Multimedia capabilities, it can provide near human like teaching with the added advantage of excellent graphics, animation's and simulations. It is relatively inexpensive and offers the advantages of interactively, dynamic graphics and simulations. It is good for both class room and distance learning modes. It can be integrated into formal, non-formal and informal education systems. The introduction of laboratory interfaces and Virtual Reality H/W and S/W will add a new dimension to the level of interaction and to the delivery systems.

3.4. ITS: INTELLIGENT TUTORING SYSTEMS:

Intelligent Tutoring Systems are extensions of CAI/CAL. While CAI depends considerably on the stored information for the presentation of information and dialogue with the student, the ITS depends upon the generic knowledge of the domain and generates the required information from the generic knowledge and presents it to the students. In this regard it emulates the human behavior. The current state of knowledge permits it, like a teacher, to develop a perception of the student interacting with it (student model), and uses it to decide the content and style of instruction. Its natural language interface provides an idealized learning environment for the individual student where the student can enter into a genuine and meaningful dialogue with the student. Though a large number of experimental systems are in use all over the world currently the ITS is in its developmental phase. The hardware requirements of ITS are the same as for CAL but the computer systems need to be more powerful. The gap between the requirements of the systems for CAL and ITS has narrowed down in the recent years because of the availability of powerful systems. (5)

3.5. COMPUTER NETWORKS

Computer networks offer very powerful environments for instructional delivery as the computers are interconnected and are able to communicate amongst themselves. Both the local area networks and the wide are networks including Internet provide many powerful options in the delivery of instruction. While each individual could work independently on different topics/ themes at different times and places and yet, communicate with each other through text, graphics, sound and video modes. This means that the networks introduce the idea of group learning while supporting and working in individualized mode. The Internet, which is a network of all the networks provide access to global data bases and support the professional learning style characterized by directed learning, learning by browsing, integrating the scattered information.

3.6. DIGITAL LIBRARIES

Libraries play an important role in the deliver of instruction. Current technologies permit digitization of books, journals, and articles, store them on computer and deliver them to the user. The user can receive the information in full or in part, for one time reading or for down loading. The organization of the book changes from the previous linear format to the hyper text format where the user has the freedom to see the book as he/she perceives and the book could contain dynamic graphics i.e. we could read the 'live' books. Digital libraries integrate the needs of formal, informal and professional segments of societies and present information.(6)

3.7. COMPUTER BASED LABORATORIES

Certain types of learning experiences cannot be delivered by the class room teaching and these experiences are provided by the laboratory. Computers have enhanced the effectiveness of the laboratory with appropriate laboratory interfaces for the acquisition and analysis of information. Further, the simulations provide a much greater understanding of the processes, systems, and concepts. They form a very effective complementary instructional delivery mode to the laboratories. The simulations, along with virtual reality provide vital experiences that are in the psycho-motor domain.

3.8 CD-I

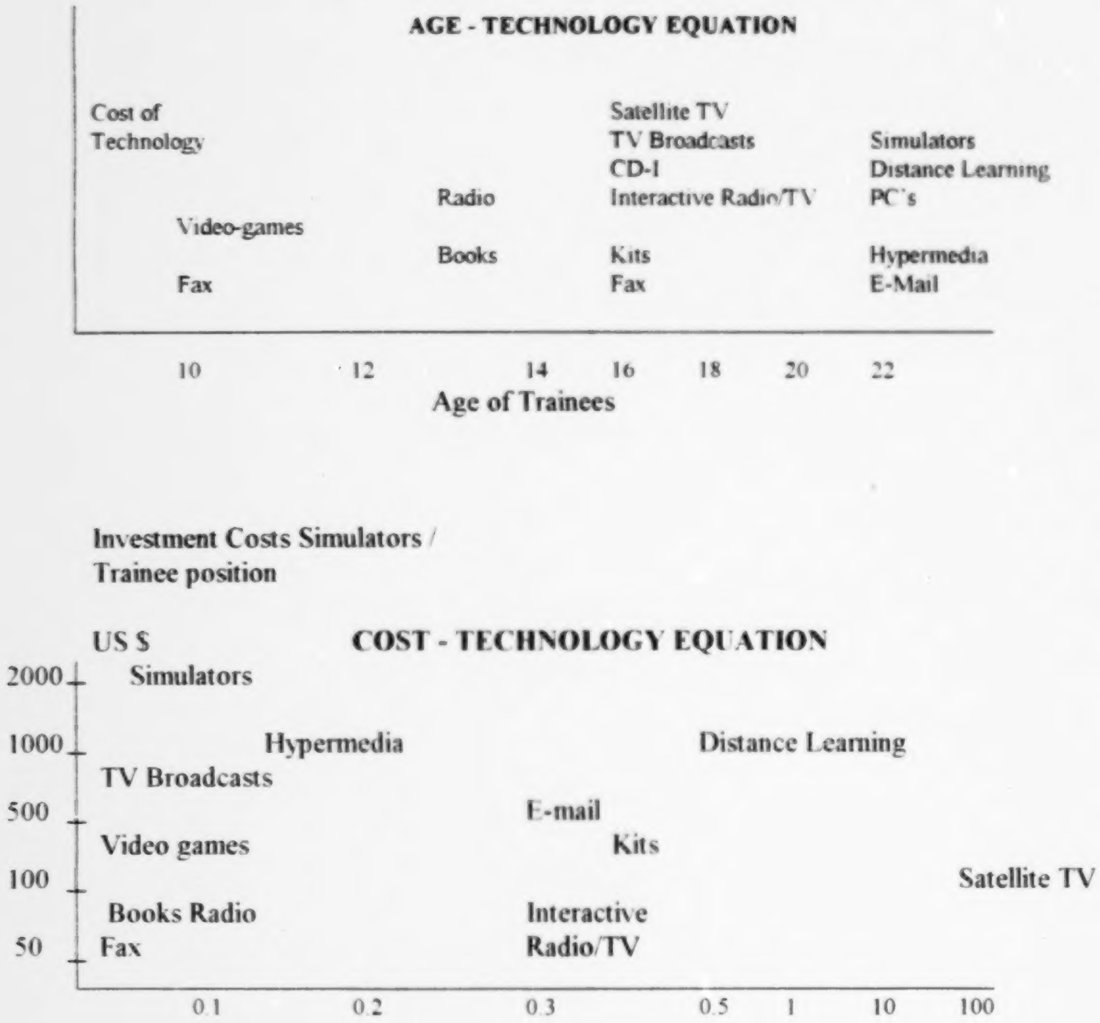
CD-I is one of the inexpensive technologies. Here a CD is often used with a CD player and a TV. The operation of the CD player is simple and can be used by relatively young students with a few minutes of training. The interactive nature of the technology combined with audio and video information on the disc, the portability and the low cost offer enormous opportunities for it in the instructional delivery. It is useful for small groups and individual learners.

4. COSTS AND BENEFITS

As can be seen from the preceding section, that most of these technologies are not new but were not exploited in the education system. Some of these are useful for individual learner, some for small groups and some for large groups. Some of the technologies allow a group sitting at one place to work independently while the other technologies, bring the people sitting at different places in the world into a single group. All the technologies complement the human effort in a given situation and are efficient in that particular situation. Research findings regarding their efficiency and effectiveness are often controversial when generalized but are supportive when applied to a specific situation. It is thus important to consider the parameters given in the beginning of the preceding section to select the appropriate technology for a given situation. It is also difficult to talk about cost benefit ratio in general terms. For instance a technology chosen for sparsely populated region for its economy may not be economical for densely populated region. While considering the costs it is necessary to consider the costs under the heads-capital costs to establish infrastructure at the central point and at the user locations, running expenditure, S/W development costs. Figure-1 shows some information that will be helpful in selecting the technologies based on the age of the learner and the cost of the technology. (7)

5. TEACHER EDUCATION

Since most of the technologies/delivery systems are new to the teachers, it is important to have the key personnel from each institute trained in the use of the concerned technology and its implications to the educational system. It is possible that the role of the teacher changes considerably while using some of the technologies and this should be given careful consideration in



Approximate Price ranges Operations costs/trainee hour

Note - The position of some of technology can change drastically depending upon the technology ownership

FIGURE - 1

the training programmes. Further the issues in the development or adoption/adoption of software/courseware should be discussed with the teachers. The teachers also need training in the production of instructional materials. The key personnel who are already trained may be used to train the other teachers in the Institutions.

6. INSTRUCTIONAL MATERIAL PRODUCTION

The availability of relevant instructional materials is the key to the success of the technology adopted. There are two choices develop the instructional materials or adopt/adapt the existing materials. Often the materials being situation and culture specific the latter choice becomes difficult. Further, even from the cost point of view also the latter choice becomes impracticable except in the case of very small countries. However the production of instructional materials is a time consuming activity and thus requires some sort of co-operation between the institutions and co-ordination in the developmental efforts. It may also be worth considering an international collaboration in the region for producing the materials. Before the production starts, it is important to draw standards for the documentation of design, lay down standards for development and plan for utilization.

7. IMPLICATIONS

Some of the technologies such as the CAI, ITS, Digital Libraries and Internet have far reaching implications. In an extreme case we may have to face the situation of virtual laboratories, virtual library or even virtual universities (universities under the staircase). The libraries all over the world are likely to be integrated in a seamless manner. The digital libraries and digital publishing may have the following implications.

- Books may have nonlinear structure and may adapt Hypermedia approach
- Who will author the books in the fast changing technological scenario?
- The fast changing technologies create a situation where the knowledge will exist in a fragmented manner with a large number of people and often not confined to the university boundaries. In such cases what would be the form of the 'books'
- We may be able to purchase a 'book' in full or in part or purchase it for one reading or purchase to own it.
- Delivery of the books will be on-line (like on Internet)

The CAL and ITS can assume importance because of their interactive nature and their suitability for delivery on Internet. Internet will become one of the important delivery systems. Since Internet could be used to deliver structured instruction as well as unstructured materials, a balance between the two modes is to be worked out. The unstructured hypermedia mode offers many advantages to the continuing education of professionals. However when used with younger groups it raises certain issues that are to be addressed by the education system and some of these issues are briefly mentioned below:

- How does a student who is accustomed to systematic teaching respondate to hypermedia approach?
- How do we take care of cognitive mapping of information (needed for understanding and application) in the case of younger learners gathering fragmented information on Internet?
- How do we take care of students 'wandering' in cyber space?
- How does the student take 'notes' in the case of BBS, Hypermedia, and conferencing sort situations?

Thus the future of exciting and challenging. The technologies are looking for applications and it is for us to make use of them in an innovative manner.

8. REFERENCES

(1) Camer H., Grese S., 1982, Bridging the gap: Towards a policy and strategy for film and Television in the developing world.

(2) Lohia R.R., 1982,Implications of the Introduction to television in Papua New Guinea, Proceedings of the Congress CILCET, Austrin film and Television School study.

(3) Durr A., 1986, Television and Children, A special Medium for a Special Audience ,Bevaly Hills,California.

(4) Arnove R.F.,(ed),1975 Educational Television; A policy criteria and guide for developing countries,New york.

(5) Goodyear Peter, 'Expert Systems and Intelligent Tutoring , Some issues in the Engineering of Pedagogic knowledge.

(6) Rixon Paul, 'Some Basic Principles of conferencing Techniques'

(7) Pau, L., F., 'The selection and use of New technology and vocational training in the developing countries' at the expert group meeting of H.O. , Turin in Dec, 93.

Multimedia Distance Education Experiments in Japan
-Three Site Debate Trial by MPEG2 over ATM System-

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1. Abstract

This paper reports the Remote Debate Experiment which was carried out in last winter as one of the Multimedia Education Network Experiments Project (MENE Project).

ATM network was connected among three sites: Kobe University, Chiba University, and National Institute of Multimedia Education(NIME) in Chiba. The ATM network and MPEG2 video CODEC (encoder and decoder) were shown to be effective in providing a virtual debate space.

2. Introduction

B-ISDN is expected to be installed everywhere in near future. Facing with coming multimedia age, we should solve the important questions: How can we enhance the education by multimedia technologies? How should we apply Multimedia tools in the school education? And what impact would these tools have on students?

Multimedia tools will affect several situations of the society. We are now beginning to investigate the effective ness and influence of multimedia technologies in running parallel to develop the communication systems.

The MENE Project, which is multimedia communication technology, examines how the present technology can be used in multimedia education.

This paper reports the Remote Debate Experiment (RD Experiment). We have demonstrated how future students might use multimedia communication tools in their classrooms.

The RD Experiment was conducted among three sites: Kobe University, Chiba University, and NIME in Chiba. The distance between Kobe and Chiba is about 480 km in a straight line. NIME is about 5 km from Chiba University. Ten students from each junior high school attached to Kobe University and Chiba University served as debaters at their respective sites, and the referee was sat at a studio at NIME.

Each site was connected by the remote communication system. This system used MPEG2 video CODEC and ATM network.

The purpose of the experiment was to observe the actions of the students in the debate trials and to collect their opinions on remote communication systems, and then to use that data to analyze the performance and the technical issues of multimedia communication tools for use in the twenty-first century.

3. Experiment

3.1 Summary of Experiment

The RD Experiment was prepared by three phases: The first phase was intended to test the network connectivity and adjust the communication systems to be used. And at the same time, the students of each Kobe and Chiba junior high school experienced the long distance communication by the system, and the students met each other for the first time. At this time the students did not perform debate trials. The second phase experiment was leaning the debate. The junior high school students who took part in last year's national debate tournament had come and showed the debate demonstration. The third phase experiment was a take of the debate, between the students of Kobe and Chiba Junior

High School. The purpose of the Second and the Third experiments was to compare the feeling of the expert and beginner debaters, and to determine the role the remote communication system played in the debates.

The first phase experiment was carried out on 11 November 1996, second on 14 December 1996, and the third on 8 February 1997.

3.2 Experimental environment

Kobe University, Chiba University, and NIME were connected by experimental ATM network called the "Joint Utilization Test Network of Multimedia Communications", provided by NTT (Nippon Telegraph and Telephone Corporation). This network topology was star type centering on NIME. This experiment used the Virtual Path bandwidth of 12 Mbps.

The configuration of the network connection was different each time, because mistook made in the setup of the ATM switches, and unknown network problems were arisen. The composition of network is shown in Figure 1 and 2.

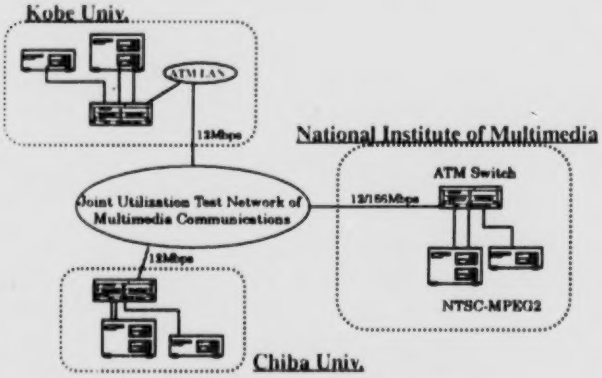
Kobe Univ.
ATM LAN
12Mbps
National Institute of Multimedia
ATM Switch
Joint Utilization Test Network of Multimedia Communications
12/156Mbps
12Mbps
NTSC-MPEG2
Chiba Univ.

Fig.1 composition of experiment network

The NTSC CODEC had an MPEG2 algorithm format. This CODEC's MPEG2 performance class was Simple Profile at Mail Level(SP@ML), and the coding and decoding delay time was about 0.3 millisecond. Analog video signal from the NTSC video camera was used. Analog audio signal input was used, with two audio channels in the MPEG1 audio mode. The output data rate generated by the encoder was 5.814 Mbps as CBR. Several kinds of output data rates could be selected (from 5.184 Mbps to 31.104 Mbps). The compressed data was transmitted and received using ATM cells. This CODEC supported AAL-5 to interface to the ATM network. A camera and microphone connected to the encoder. Audio and video encoded by MPEG2 were sent to the ATM in real time. A TV monitor and speakers connected to the decoder played the audio and video decoded from the data received from the ATM network. The encoder and decoder were connected to the ATM switches by optical fiber. In the experimental network, an encoder at any site could be connected to a decoder at any site by setting the connection of the ATM switches.

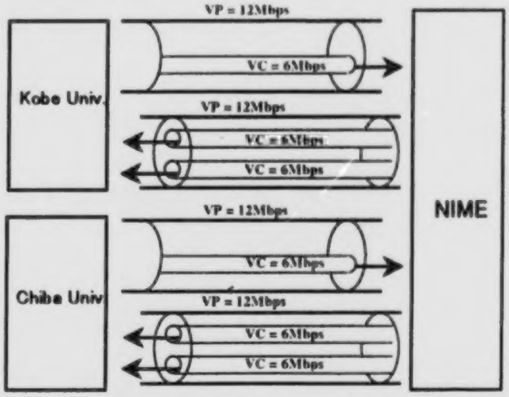

Fig.2 Bandwidth of experiment ATM network

The first experiment was carried out only between Kobe and Chiba. Because a problem was happened in this time at NIME. Only Chiba and Kobe could exchange data each other. We did resolved this problem after that, the cause of this problem was mistook the setup of traffic shaping of ATM switches in NIME. The composition of the first experiment is shown in Figure 3.

The second experiment was carried out between Kobe, Chiba, and NIME. The MPEG2 data encoded at each sites was sent to the ATM switch at NIME. In the ATM switch at NIME, the received data was copied by multi-cast mode and sent simultaneously to the decoders at other both sites. The composition of the second experiment is shown in Figure 4.

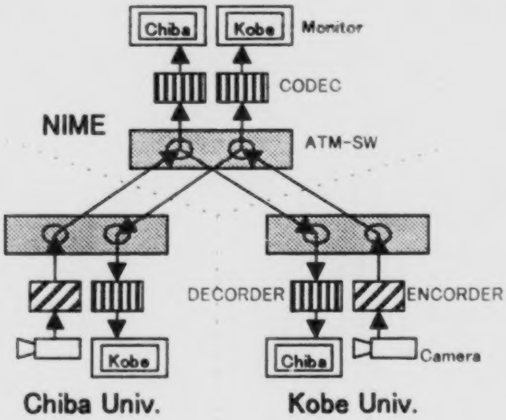
Chiba
Kobe
Monitor
CODEC
NIME
ATM-SW
DECORDER
ENCORDER
Kobe
Chiba
Camera
Chiba Univ.
Kobe Univ.

Fig.3 composition of first experiment

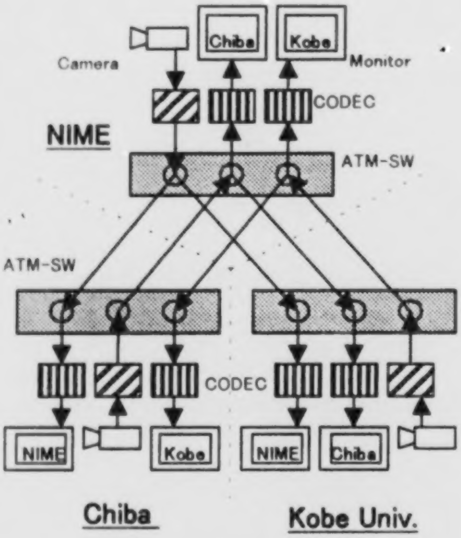
Camera
Chiba
Kobe
Monitor
CODEC
NIME
ATM-SW
ATM-SW
CODEC
NIME
Kobe
NIME
Chiba
Chiba
Kobe Univ.

Fig.4 composition of second

The third experiment was also carried out between Kobe, Chiba, and NIME using the same procedure as the second experiment. But only one connection was made for sure at each site because of the network trouble. This problem was the Kobe and Chiba could received only data of 6 Mbps from NIME. We supposed the occurrence of disposed of the ATM Cell on somewhere in ATM network. We could not resolved cause of this problem yet. So the data from the two other sites had to be multiplexed. The composition of the third experiment and multiplexed is shown in Figure 5.

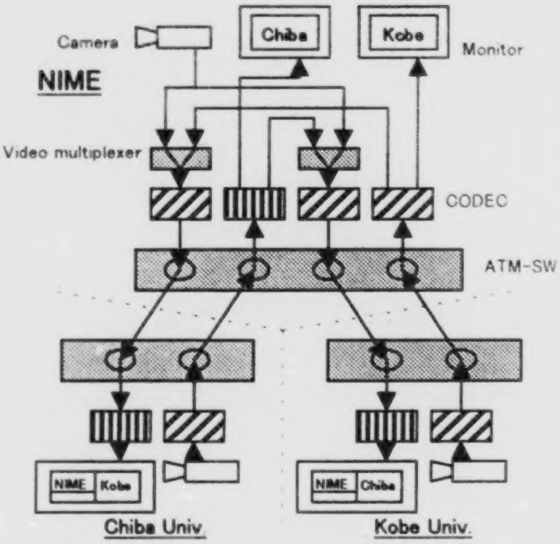
Camera
Chiba
Kobe
Monitor
NIME
Video multiplexer
CODEC
ATM-SW
NIME
Kobe
NIME
Chiba
Chiba Univ.
Kobe Univ.

Fig.5 composition of third experiment

This video multiplexer decoded and multiplexed the data from Kobe and Chiba with that of NIME. The multiplexed data was encoded and distributed to Kobe and Chiba. Only the data from NIME was copied by multi-cast mode of ATM switches.

The pictures on TV monitor of the remote communication systems frozen occasionally. The effect was similar to what happens with loss of ATM Cell at some ATM switch in the Public Network. These were two factors underpinning this problem. One was that the MPEG2 CODEC sent data at the maximum rate of the network. The other factor was the buffer size in the ATM switch in the Public Network.

Occasionally there was troubled with sound transmission. During the troubled times, we had replaced to use portable telephones.

3.3 debate

In the first experiment, students with no previous debate experience were invited to chat using the system. The students would later in the third experiment. This experiment was carried out to get the students used to talking in this environment and to test the connections. The junior high school students at the Chiba site were not able to take part in this experiment, so the students at the Kobe site introduced their school to the college students at the Chiba site.

In the second experiment, experienced debaters came from the two schools, who took first place and third place in last year's national debate tournament, had a debate trail on the proposition, Resolved: "That Japan should have a daylight saving time system". The inexperienced students who were invited to the first experiment introduced themselves before the debate and observed the debate.

Before the third experiment, two experts gave an intensive seminar lasting a few hours in debate to those students who participated in the third experiment. In the third experiment students debated the resolution, Resolved: "That Japan should introduce English as an independent subject in the primary school education".

3.4 results of the experiment

We hope to answer several question in these experiments. The first was whether the student debaters would find it more difficult to exchange arguments through only the video camera and TV monitor sets in front of them. We thought it would be more difficult for them to communicate using this system.

One of the debaters said that he found it difficult to project his inner feeling to his opponents due to the lack of direct interaction. It seems that this comment ironically justifies the use of this system for debate in that the debaters cannot resort to emotional appeals but must rely on verbal messages.

Another debater who took part in the first debate said that it was rather difficult to look at the video camera and the two TV monitors at the same time. This problem was mitigated in the second debate by placing the TV monitors closer to the video camera and putting the pictures of the two other sites on one screen. The composition of debate stage of second experiment and format of multiplexed TV monitor in Figure 6 and 7.

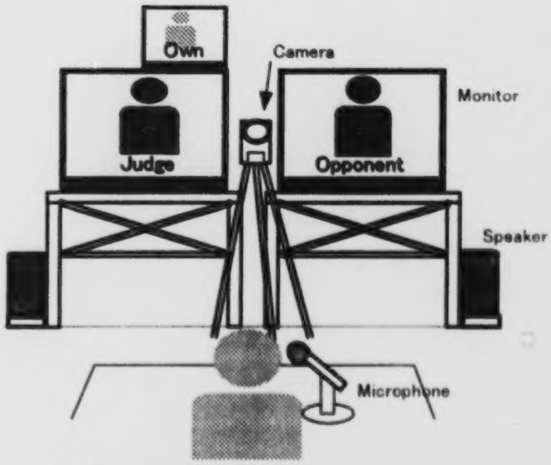

Fig.6 composition of debate stage of second experiment

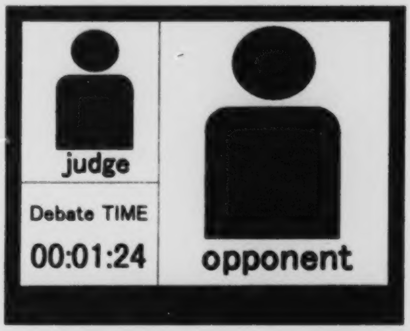

Fig.7 multiplexed video monitor

Following the debate rules adopted by the national tournament, debaters were not allowed to show any visual aids. This rule preempted the problems caused by frozen pictures on the TV monitor in that the monitors did not send any information directly relevant to the debates.

Some debaters said that it was easy to see how the judge reacted because there was a monitor showing the judge throughout the debate. In regular debates, debaters seldom see the judge(s), but in this setting they were able to see the judge thanks to the monitor. Some debaters in the second debate also said they found it difficult to hear their opponents from time to time. We think we could have prevented this problem by adjusting the sound volume and teaching the students in advance how to use the microphones effectively.

Another question we hope to answer is whether an experienced judge particular difficulty judging the debate. The judge in our experiments said that he perceived no significant difference between the remote debates and regular debates. He also said that he felt that we could even hold a debate tournament using this system.

We would like to point out that the students actively engaged in informal talk with the students at the other site after their debate. They seemed to enjoy themselves a great deal, and some of them even shared their addresses and phone numbers. Therefore, it might be better to have them talk informally first before the start of debates.

4. Conclusion

The remote communication system using ATM and MPEG2 technology proved very effective for the remote debate. The debaters, The judges, and the experiment staff could communicate well with this system. Of course, this system had many problems: frozen pictures, voice echo, forward delay of picture and voice, loss of ATM Cell in the network, and equipment expense. These problems need to be addressed. This experiment confirmed the importance of voice in remote communication. Even if we can see a speaker's face, if we cannot hear the speaker's voice, communication will become much more re-trying. The delay in voice transmission made most participants feel uncomfortable. We must give sufficient thought to voice when developing remote communication systems.

The remote debate experiment confirmed the possibility of using multimedia communication tools in education. Multimedia tools will soon be used in many factor of education.

Acknowledgment

The authors would like to acknowledge all staffs of RD experiments, at NIME, at Kobe University, at Chiba University. Authors express their thanks especially to Kobe and Chiba Junior High School students and theirs teacher. Furthermore, they are grateful to Prof. Hiroaki IKEDA of Chiba University, Prof. Keizo NAGAOKA of NIME and Prof. Toshio KOBAYASHI of NIME for their cooperation in this experiment.

References

[1]S.Matumoto, K.Okamura, T.Kobayashi, S.Yamashita :"A New Era for Educational Debate :An Analysis of Educational Values of Three-Site Long Distance Debates by Japanese Middle School Students", *Teaching Medical Literacy and Media Citizenship Summer Conference, The National Media Citizenship Project*, June 20-22, 1997.

[2]R.Suzuki, T.Komine, F.Kubota, K.Nagaoka :"Multipoint Distance Education Experiments", *IEICE*. D-712, 1996

[3]M.Itou, H.Higaki, T.Komine, K.Nagaoka :"Comfortable Environment for Remote-Debaters –Display Effect on Remote-Debaters-", *JSiSE, Transaction of Japanese Society for Information and Systems in Education* Vol. 14 No.3, August 1997

Virtual Classroom, Virtual Learners

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In this paper, we look at the challenge of distance education in both its synchronous form (virtual classroom/virtual university) - via videoconferencing, audioconferencing, Internet live chat and other realtime technology - and in asynchronous forms (self-study, theInternet email).We wish to explore the new learner paradigms that are merging from the application of this new technology. As we make the learning experience virtual, we can ask if the skills learners need to succeed have changed. In this paper, we focus on our research results in this area. Which learners succeed in the various distance learning modes? What specific attitudes and behaviors do these successful virtual learners possess? Can we teach these attitudes and behaviors to people who have adapted to traditional learning? We will examine 4 years of experience at Marpet University, Temasek Polytechnic (Singapore), University of California Santa Cruz Extension and the Universidad Autonoma de Nuevo Leon (Monterrey, Mexico) with all these virtual learning modalities.

Marpet University has been experimenting with various modalities for distance learning since 1991. In addition, local Universities that the authors are affiliated with have allowed them to experiment with non-traditional learning in both accredited and non-credit courses in data communications, networking and telecom. Experiments have shown that combinations of synchronous and asynchronous modalities deliver the greatest learner benefit. As learning institutions increasingly embrace non-traditional delivery mechanisms, it is important that we study the learner characteristics that make learning more successful in this new world.

A rich body of research exists concerning the characteristics that make a person successful in traditional learning mode (lecture). Classes exist to teach those who do not naturally exhibit "successful learner" characteristics to develop these characteristics. They are usually titled "How to be Successful in XXX" where XXX can be 3rd grade, graduate school, on the job training or aceing the scholarship exams. If interactive distance learning and multi-modality distance learning require different skills, we need to identify what these skills are so we can teach them to our learners.

We expect this research to complement the research ongoing that is studying what the conveyers of the learning have to do to convey the learning most effectively. The most powerful lesson of the new paradigm is that learning is now an active, not passive, process.

Our research indicates that some traditionally successful learners are more successful in synchronous learning modes (presumably because it most closely resembles traditional lecture mode), but much less successful in asynchronous and mixed sync/async environments. Our research also indicates that virtual learning success skills can be learned. Since our earlier research indicates that mixed sync/async learning promotes the highest level of demonstrated knowledge transfer, we will zero in on this environment in detail, looking at why this should be, and how we can promote learning skills for this and other modalities.

1. Shared Learning

1.1 Looking at Marpet University's Learning Environment

* Need Async as prime component to cut loose from time/place/distance.
* Need to prevent straggling with a stressed population, so some sync component required.

1.1.1 Solution: Shared Learning

* The primary vehicle for learning is self-study.
* The second vehicle is the study group.
* The "instructor" facilitates and coaches.
* Learners get materials and get into study

groups on the kickoff day.
- Due Dates assigned for all components.

1.1.2 Expectations & Assumptions About Learners

- We expected a motivated, self-selected group. In contrast, most learners didn't know it wasn't a lecture experience (for the first 2 years)!
- We hoped that they would learn as much as the lecture group, with a small decline in grades. What we saw instead was a significant increase.
- We defined "learning" quantitatively, as numerical performance on standard tests

1.1.4 Components of Shared Learning

Required: Self-Paced Workbook, Quizzes (Hand-in reviews), Project, Final exam (only this is live) Optional: Q&A sessions, Study groups, Internet email, AOL chat, Telephony office hours

1.1.5 Study Groups

All learners were required to join a live group, if possible. No constraints on time/place of meeting, including evenings/weekends/lunch. Groups generally met once/week.

1.1.6 Live Meetings

There are live meetings: 4 Q & A sessions, 90 minutes each, at lunchtime. To answer questions from study group ONLY. Handins graded in class for immediate feedback.

1.1.7 Telephony Office Hours

For a total of 2 hours/wk, to ask the instructor questions not resolved in study group

1.1.8 Internet Email: To the Instructor

- For specific questions, not resolved in study group

1.1.9 Internet Email: To Each Other

Learners used email to prepare for live study group meetings and live Q&A. They used email to share answers, ask questions, build team spirit. Asynchronous learning.

1.2 Are Specific Learning Styles Correlated with Success in Shared Learning ?

1.2.1 Success of Study Groups

In the beginning classes, the learners who attended more study group (synchronous) meetings tended to do better. There was no correlation with attendance with the more advanced classes because:

- Some advanced learners 'didn't need help" and stayed away
- Several learners came to "be sure they didn't miss anything" and "get a better grade". An additional reason, we believe: human contact.

1.2.2 Success of Telephony Hours

- Learners at first tried to avoid actual working by calling (shifting responsibility back to the instructor to "spoon-feed me").

1.2.3. Success of Internet Email & Chat

- 84% used email at least once. 45% were heavy users of email.
- Chat was a hassle for many who are not technically savvy.

1.2.4 Conclusions

During the initial (prior to the current study) research period, we came to some obvious conclusions about the learning process. For instance, looking at the individual grades, we could see that the overall competency level increased as the quarter progressed; the average grade per handin climbed. There was a dramatic shift at just after the mid-quarter mark. This was the point at which the learners really incorporated the realization that the old "come to class and listen" paradigm was dead. Those who had not been self-regulating their learning hours (doing the required work) were prodded by poor grades and by their study group to get with the program.

The mental transition that the learners made was from seeing the instructor as the primary architect of the learning process; they realized that they were responsible for getting the learning done - or not. The instructor is a facilitator and coach. Learners forced to take responsibility for their learning complained mightily but learned more thoroughly.

This is where we were a year ago - with a promising direction but nothing more than anecdotal answers to this fascinating question.

New Research

In order to answer this new research question, every instructor was asked to rate incoming learners on a list of characteristics, from degree of intrinsic interest in the subject, degree of employer-induced interest and/or anxiety, to the learner's experience with non-traditional learning, the learner's experience as an entrepreneur and other "no-one else to blame but me" situations. We also tested optimist/pessimist/realist characteristics on a qualitative scale. We then correlated these learner characteristics with actual final grades.

Results from 3 quarters have been analyzed. The quantitative results suggest that successful New Learners have the following characteristics:

1) a background as an entrepreneur, or other experience of a "buck stops here" no-excuses nature, or prior experience with non-traditional (non-lecture based) learning

2) a strong intrinsic motivation

3) no expectation that the learning-facilitator (instructor) would be entertaining, provide extrinsic motivation, "make the learning fun," etc.

All of which culminated in 4) a paradigm shift from passive learner mode to active learner mode.

We also looked at the results of comparison of 1 quarter of classes in which videoconferenced students were compared to Shared Learning and regular lecture students. In our study group, learners in synchronous non-traditional learning (Kinko's videoconfercing) behave very like traditional learners. Most of what synchronous learning does is vanquish distance, but you are still in passive listening mode vis-à-vis an instructor. We believe that we did not see a significant difference between videoconferenced learners and traditional learners because it is only an asynchronous component that forces the "instructor" to become a learning facilitator and the learners to take responsibility for learning. This is our opinion, based on an inadequate sample.

Let's drill down to some of the details in these concepts:

(1) Responsibility of learning

In lecture-based, synchronous learning, using videoconferencing, satellites or whatever to increase the range of the lecture, the specific timetable and location takes the first step on the road to making the learner become passive towards the learning environment and the learning process. Of course, this is the learning paradigm that we all grew up with, from our earliest experience of learning, uninterrupted to the present for most of us.

On the contrary, the asynchronous mode allows learners a higher degree of flexibility to arrange their own schedule and training progress. This freedom encourages the learner to be responsible for their learning. Successful learners in our study took responsibility for their learning of both content and process. We saw this occur not only in their verbal communication, but in actual action. The highest grade-earners, and the happiest learners, took the stance: what do I have to do to make it happen? This occured after about 4 sessions, even in the groups that did NOT sign up for New Learning.

(2) Time management

With the flexibility of asynchronous training, learners often have the choice to determine their time schedule and the duration of specific bouts in the learning process. Good skill in time management is essential to meet assignment deadlines and lesson revision under this new mode of learning in which you don't have your instructor nagging you like a 5-year old and reminding you many times of all relevant deadlines.

Also - and not an inconsiderable advantage - learners in asynchronous learning mode have more time to devote to actual learning than those in synchronous mode as they do not need to spent time in traveling to the learning location (school, institute, whatever) on a rigid schedule - usually during peak commute hour! Even though more time is available for learning, learners must have the proper time management in setting priorities and exercising self-discipline.

(3) Goals and planning

Many learners enrolled in both virtual and traditional classrooms are working full time and also have family responsibilities. We observed (as many other researchers have before us) that many learners do not have an overall plan and goal when they register for their program. Successful New Learners, on the other hand, have a clear goal and realistic planning of what they can achieve and the time needed to devote to the course to be successful.

Of course, the difference that we see in the successful virtual learners is precisely this issue: they understand that they cannot plan to simply show up and expect the learning process to happen magically (and blame the instructor when they don't learn). If the instructor were only more entertaining, I would have learned the material successfully!

The successful learners in our study had realistic goals, they knew what they could and could not accomplish with the time they had available amidst job, children, aging parents and their own needs for exercise, recreation and relationships. The optimists (who have been praised in best-sellers for having the best mental and physical health) actually performed substantially less well, grades-wise and happiness-with-the-process-wise, than the realistics who did NOT think they could pull additional hours out of their magic hat at will - or short-change other areas of their life without paying a price.

Other factors that are advantages to learners in mixed synch/asynchronous mode include:

(1) Virtual library --- To supplement the trips to the library, many New Learners, in our study and others, made use of Internet searches for information. Marpet University does not have Internet access provided for learners, but other institutions do. (We assume everyone has a Web browser and ISP connection.) It can be argued that the purely synchronous mode of learning can also utilize public databases and the Internet as a supplement to the learning process. The advantage for learners with some asynchronous training is that they have fewer needs to travel to the classroom and therefore could use such time to access the Internet.

(2) Email discussion groups in asynchronous mode — Learners use email to contact their instructors and tutors.

A successful implementation that uses Lotus Notes and Internet Technology can be found in Athabasca University in Alberta Canada (reported by Dr. Stephen Murgatroyd at the GlobeComs conference in Calgary, June 1997). By using the Internet and email, learners' group discussions can take place both synchronously and asynchronously.

With asynch learning, messages and comments are exchanged when convenient and discussion and feedback can be retrieved when the learner is again available out of their busy schedule. This makes the learning more efficient and effective when many recipients can be sent the same email of a discussion. An added benefits is that learners have time to organize their questions and formulate their arguments clearly in writing.

Universidad Autonoma de Nueva Leon (UANL) in Monterrey, Mexico, has been presenting its degree candidates in electrical engineering and networking with the challenge of sending and receiving course materials via the Internet, list servs, and an internal network. Learners who use the online study services most extensively are the higher-grades earners, but comprehensive studies of the reasons for this have not been completed. We hope to report these results later. Professor Leopoldo Villarreal Jimenez (lvillarr@gama.fime.uanl.mx) is heading up this networking effort.

MU found that those who engaged in group interactions did better, and not just by "picking each other's brains." Parenthetically, we discovered that the tendency of the lazy ones to "use" the group was limited by the group's ability to eject un-collaborative persons. And finally, of course, group effort and the laziness factor are endemic aspects of business life in North America. We relied on the threat of ejection (and having to work alone for the rest of the quarter) to keep flagrant cheaters in line. We only had 3 failures in 3 quarters.

(2) Higher degree of comfort in participation

In early types of asynchronous training, learners did not meet face to face. Even in advanced systems like ours and other similar systems, much work occurs via email. This can sometimes be an advantage! (Although some contact is important, as we have reported earlier.) Here is how anonymity helps: When it comes to debate, discussion over email or questions to instructors, learners often enjoy a higher comfort level in terms of their perceived embarrassment of wrong answers. This is well-known to have an impact in Asian, and Asian-derived (immigrant) cultures, but we consider the disinclination to "look stupid" pretty darn close to a human universal!

In addition, some persons involved in the learning process are not as ready to face the 21st century challenge of multi-cultural, non-sexist, non-racist, non-agist life as they would like to be - or others think they should be. These individuals have told us that they can work more comfortably with each other when they DON'T have to see them in person (and confront their prejudices). These individuals will improve their overall achievement level in an asynchronous collaborative effort.

In summary, there are definitely indications that a successful New Learner can be brought into existence with training in How To Learn under the new regime.

Conclusions

In the synchronous model, learners may over-rely on the instructor to provide them with the learning experience. Learners too often today play a passive role in the learning process. Very often, instructors feel themselves and are considered to be responsible not only for coaching learners through the material to be learned, but also for motivating learners to participate.

In the combined synchronous & asynchronous model, some learners develop a high degree of self-discipline, maturity and self-directed learning once they get adjusted to the system. Others, of course, will need more time to learn how to be New Learners, and we are experimenting with ways to teach these new skills.

Teaching New Learning Skills

We did a 1 quarter study of effective teaching of New Learning skills, not enough for a statistical analysis but enough for some generalizations.

* Classes where we provided step-by-step instruction on How to Learn on Your Own and How to Run A Study Group "got with the program" faster.

* Persons with rigid attitudes toward the PROCESS (I"ve never done it that way before; my culture doesn*t do that, etc.) tended to cluster in the lower grades. Unfortunately, immigrants tended to be the most resistant to new processes. This is a problem for them, as more learning will be presented in unfamiliar ways in the 21st century. The persons in our study who most resisted learning new skills dropped back to traditional lecture classes in subsequent quarters.

* The most intrinsically motivated, most entrepreneurial and most realistic people also were most open to learning new modes of learning: they were most open to changes in the process because entrepreneurial experiences ahve made them more open-minded in general. More realistic people also tend to be more flexible in their thinking.

* Those who were more computer literate and had more experience online did NOT necessarily do better as New Learners. They were not necessarily more open to new processes in general, nor were they easily shifted into self-motivation. They did not spend mroe time on task, which is always the chief predictor of a successful learning outcome. We look forward to more studies on teaching New Learning skills. Please contact us at marpetu@home.com for more detailed information.

Social Welfare Consequences of Privatization in the Telecommunications Industry

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Abstract

This paper measures the changes in economic performance of formerly state-owned enterprises (SOEs hereafter) under the alternative regime of government and private ownership. The analysis is focused on the changes in the performance of privatized telecommunications operating companies (telcos hereafter). Further, this paper sheds some economic lights on three fundamental questions of privatization: 1) should the firm be sold? 2) at what price should it be sold? and, 3) to whom should it be sold?

I empirically tested above research questions and found that the economic effects of privatization in the telecommunications industry were desirable. Empirical results shows that the widely used privatization scheme of underpriced, partial offering through capital market is optimal and this scheme might be preferred to tender sale to the third party.

1. Introduction

We have witnessed a significant global shift away from state socialism towards entrepreneurial capitalism for the last two decades. Governments around the world have sought to generate growth and to reduce structural inefficiency by removing the artificial barriers and opening the economies up to competition. In this trend, privatization - the transfer of assets from the state to the private sector - has played a major role in economic liberalization. Privatization represents a natural response to the pressure of global competition, especially in the telecommunications industry, which has been traditionally regarded as natural monopoly in the domestic market.

Governments have promoted the private ownership of formerly state-owned enterprises, recognizing that investors in the markets will provide more efficient monitoring on the worth of an investment than taxpayers and government that represent them.

The economic effect of privatization is usually analyzed by cost-benefit approach.[1] Empirical findings are few using this approach, because the arguments in the model are too abstract. Thus, I will introduce cost function to measure the social welfare consequences of privatization. Theoretical analysis will be applicable to all of the industry considered, but empirical evidences are obtained only for the telecommunications industry. Finally, I will analyze the term of selling contracts, e. g. selling price, selling fraction of stake, and analyze the stylized fact of gradual, partial, underpriced sale of privatization program.

This paper is organized as follows. Section 2 introduces the fundamental formula of privatization along with implications for the privatization decision by the government. Cost function and empirical findings are presented in section 3 to decide the social welfare consequences of privatization in the telecommunications industry. In section 4 and 5, I consider the economic effect of terms of contracts used in privatization. Section 6 presents summary of the findings.

2. Welfare consequence of privatization

2.1 The fundamental formula of privatization

When the government considers privatization of an SOE, the first question that should be raised is "Should the SOEs be sold?" In general, the SOEs are state owned because there exists market failure or natural monopoly. This means that public production of outputs may be more socially desirable than private production. Thus an SOE can be privatized only if there is positive economic consequences resulting from privatization.

To analyze the economic effect of privatization, let us define key variables.

V_{sg} : social value of the firm under

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[1] Cf. Jones et al. (1990) and Choi (1997)

<table 1> estimates of λ_g

Country	λ_g estimate	Researcher
Colombia	2.5	Schohl (1979)
Egypt	1.2	Page (1982)
Malaysia	2.2	Bruce (1976)
Philippines	3.48	Bruce (1976)
Thailand	2.54	Ahmed (1983)
Turkey	3.37	Mashayekhi (1980)
US	1.17-1.56	Ballard et al (1985)

(source) Jones et al. (1990)

continued government operation,

V_{sp} : social value of the firm under private operation,

λ_g : shadow multiplier on government revenue,

λ_p : shadow multiplier on private funds,

Z : actual price at which the sale is executed

If the government decide not to divest the SOE, then society would enjoy V_{sg}. Otherwise each potential buyer calculates V_{sp} which may be different for each buyer since its ability to reallocate the assets of a firm is different. Thus we can define the change in social welfare as a result of the sale to any potential buyer;

$$\Delta W = V_{sp} - V_{sg} + (\lambda_g - \lambda_p)Z \quad \text{---- (1)}$$

The combined effect of first two terms measures changes in social welfare resulting from the new incentive structure after sale, and the last term shows the social value of the sale proceeds. This equation is developed by Jones, Tandon and Vogelsang (1990) and is called *fundamental formula of privatization*.

2.2 Privatization decision

Now we can decide the social welfare consequences of the privatization decision. To improve social welfare, ΔW must be positive; otherwise the government should not sell the firm. In short,

$$\text{Sell only if} \quad \Delta W = V_{sp} - V_{sg} + (\lambda_g - \lambda_p)Z > 0 \quad \text{---- (2)}$$

In inequality (2), we are sure that the last part of right hand side of the equality is positive. First, Z is always positive. Next, it is generally accepted concept in the academics that the relation [$\lambda_g > \lambda_p$] holds, based on the ability of taxation by the government. This relation is supported by the empirical studies for various countries. Empirical estimates of λ_g, assuming $\lambda_p = 1$, for selected countries are presented in <table 1>.

Then, if the inequality [$V_{sp} - V_{sg} > 0$] holds or is not significantly negative, then the government should sell the SOE. I will ascertain the relation by comparing cost function of each privatized telco.

3. Should the SOE be sold?

3.1 Cost-benefit approach and cost function

The cost-benefit approach has been developed and widely used for last 20 years and is the most widely accepted approach among economists. But empirical estimation of the variables in the model is next to impossible because the variables in the equation are too abstract. Thus I will compare cost function of the respective regime.

This approach is based on the duality theorem, which means that, in competitive equilibrium, profit maximization is equivalent to cost minimization. Privatization changes the incentive structure of the managers and employees, and allows them to pursuit profit maximization. Thus we can ascertain the effect of privatization by the cost function. If the firm produce more output using the same input, then we can say the privatized firm increase the social welfare assuming that the price (rate) level is unchanged.

3.2 Cost function and the regression parameters

Assume Cobb-Douglas production function.

$$Y = A \cdot K^{a1} \cdot L^{a2} \quad \text{----- (3)}$$

where Y = annual output.

K = capital stock.
L = labor.
$a_1 + a_2 = 1$,
A = constant

and cost function

$$C = P_K \cdot K + P_L \cdot L \quad ----- \quad (4)$$

where P_K, P_L are factor price of K and L, respectively.

Then, profit function can be transformed as;

$$\pi = A \cdot P \cdot K^{a1} \cdot L^{a2} - P_K \cdot K - P_L \cdot L \quad -----(5)$$

where P is sale price per output.

Differentiate the profit function with respect to K and L, and equate the two first order conditions, then

$$a_1^{-1} \cdot P_K K = a_2^{-1} \cdot P_L L \quad ---- (6)$$

Substitutes equation (6) in equation (3), and rearrange the terms, then,

$$K = A^{-1} \cdot a_1^{-a1} \cdot a_2^{-a2} \cdot P_K^{-a2} \cdot P_L^{a2} \cdot Y --- (7)$$

Substitute equation (7) in equation (4), then

$$C = A^{-a2}[1 + A^{-1} \cdot a_1^{-a2} \cdot a_2^{-a2}] P_K^{a1} \cdot P_L^{a2} \cdot Y --- (8)$$

Take logarithm both sides in equation (8), then

$$\log C = \log a_0 + a_1 \log P_K + a_2 \log P_L + \log Y --- (9)$$

where $a_0 = A^{-a2}[1 + A^{-1} a_1^{a2} a_2^{a2}]$

To know the effect of privatization, introduce dummy variable D in equation (9), which takes value 1 if the firm is privatized and 0, otherwise. Finally, the regression model to be estimated is:

$$\log C = \beta_0 + \beta_1 \log P_K + \beta_2 \log P_L + \beta_3 \log Y + \beta_4 D --- (10)$$

In this equation, proxies are defined as follows: average return on capital for P_K, sales per employee for P_L, revenue for Y. We can conclude that the efficiency of the telcos are improved, and thus the social welfare consequences of privatization is desirable if the coefficient of dummy variable is negative.

The null and alternative hypothesis is

H_0 : The economic performance is unchanged after privatization.

H_a : The economic performance is changed after privatization.

3.3 Sample

Around the world, 31 state-owned telcos have been privatized through private sale and 24 state-owned telcos have been privatized though the capital markets share offering. The sum of privatization proceeds from private sale is US$ 20,050 million and that from public offering is US$ 55,472. Total proceeds from privatization around the world are estimated to US$ 599,749 million. Thus sale proceeds from the sale of state-owned telcos explains 30% of the proceeds from the privatization across the industry, around the world by the first half of the year 1997.

The UK based database *Privatisation International* summarizes that private sale of telcos is accomplished in the less developed countries whose capital markets are underdeveloped. The member countries of OECD have privatized smaller state-owned telcos through private sale.

Average issue size of private sale of state-owned telcos is US$ 647 million and that of public offering is US$ 2,331 million. So, we can conclude that the incumbent or major state-owned telcos are privatized through capital markets. Unfortunately, there is no publicly available financial data for the unlisted companies. Thus I will focus on the privatization through capital market.

The *World Bank* and the database *Privatisation International* identify about 25 public offerings from 21 countries. Detailed data on (initial) public offerings of telcos , are shown in <table 2>

Six firms are selected for regression analysis: KPN, Singapore Telecom, TCNZ, Tele Danmark, Telekom Malaysia and NTT. Other companies are excluded from the dataset because I could not collect enough series of accounting data.

3.4 Results

<table 3> shows the result of the regression analysis. The coefficients of dummy variable are negative in the 4 telcos out of 6 sample telcos. The coefficient of dummy is statistically significant negative for Telekom Malaysia and is significant positive for NTT. This result is consistent with prediction of the model based on the theory of information asymmetry such as Perotti (1995), Branco and Mello (1991) which assume that the performance of the privatized SOEs will be improved.

<table 2> Initial Public Offering in the Telecommunications Industry

Company(Vendor)	IPO Date	Issue Size (US$, Mn)	Stake sold	Initial Return	Gvt Stake in 97
C&W(UK)	Dec 81	466	50%	32%	0%
BT(UK)	Nov 84	4,763	50%	33%	0%
Sirti(Italy)	Jun 85	148	40%	n.a.	n.a.
STET(Italy)	Nov 85	103	3%	-37%	51.7%
NTT(Japan)	Feb 87	15,097	13%	55%	65.4%
TOJ(Jamaica)	Sep 88	19	13%	n.a.	n.a.
Telefonos de Chile	Sep 90	90	90%	6.3%	76%
Bezeq(Israel)	Sep 90	74	9%	n.a.	n.a.
Telus(Canada)	Oct 90	825	60%	0%	0%
Telekom Malaysia	Oct 90	872	24%	5.6%	0%
Telmex(Mexico)	May 91	2,170	15%	15%	46%
Telecom New Zealand	Jul 91	819	100%	20.8%	0%
Telefonica de Argentina	Dec 91	849	30%	15%	87.5%
Singapore Telecom	Oct 93	1,590	7%	75%	0%
Telecom Argentina	Mar 94	1,050	30%	7.3%	51%
OTE(Greece)	Jun 94	530	8%	8%	92%
Tele Danmark	May 94	2,894	38%	7.3%	51%
KPN(Netherlands)	Jun 94	3,868	30%	7%	48%
Pakistan Telecom	Sep 94	997	12%	117%	88%
Indosat(Indonesia)	Oct 94	1,060	35%	20%	65%
Portugal Telecom	Jun 95	998	27%	7.5%	51%
PT Telkom(Indonesia)	Nov 95	1,590	19%	20%	81%
Telefonica del Peru	Jul 96	1,100	24%	10%	5%
DT(Germany)	Dec 96	13,500	26%	19%	74%
France Telecom	Oct 97	n.a.	n.a.	13.0%	n.a.

* Initial Return (IR) : (closing price of the issue date - offer price) divided by offer price.

I do not exclude the possibility of obtaining insignificant results because the number of observation is limited. But the empirical finding shows that the effect of privatization may not be harmful but beneficial to the economy. And the reported results in <table 3> give us some meaningful implications because previous studies reports that the economic effect of privatization in the monopolistic industry is not substantial.

Similar approaches are applied to the empirical studies on the impact of privatization: Caves and Christensen (1980) applied this approach for Canadian railway industry, Levy (1981) for Iraqi manufacturing industry, and Yarrow (1986) for steel industry in the developing countries. But all of them find no evidence that privatized firms outperform SOEs. Wortzel and Wortzel (1989) also report that privatization does not contribute on improving efficiency.

Vickers and Yarrow (1991) summarize that the efficiency of privatized firms in the competitive industries are significantly improved while that in the monopolistic or protected industry such as electricity, telephone are not. Megginson et al. (1994) document that privatized firms increase real sales, become more profitable, increase their capital investment spending, and improve their operating efficiencies.

However, my results suggest that the privatization in the telecommunications industry may be socially desirable, because the last term in inequality (2) is significantly positive. Thus I conclude that the state-owned telcos should be sold to the private sector as soon as possible and the privatizing government can be more confident on the economic consequences of privatization of state-owned telcos

<table 3> Results of Regression

Company	P_L	P_K	Y	Dummy	Observation
KPN	-0.457 (-1.06)	0.124 (0.61)	1.678 (3.74)	-0.021 (-0.96)	1988-1996 (8 years)
Singapore Telecom	-0.353 (-2.59)	0.004 (0.16)	1.157 (5.41)	-0.063 (-1.12)	1983-1996 (13 years)
TCNZ	-0.185 (-1.65)	-0.139 (-4.31)	1.410 (5.37)	0.006 (0.12)	1988-1996 (9 years)
Tele Denmark	-1.007 (-1.47)	-0.022 (-1.08)	1.911 (2.64)	-0.187 (-4.23)	1988-1995 (8 years)
Telekom Malaysia	0.987 (1.14)	0.009 (0.16)	0.170 (0.23)	-0.11 (-2.8)	1988-1996 (8 years)
NTT	-0.0216 (-0.57)	0.605 (15.521)	0.0038 (0.247)	0.029 (1.515)	1981-1996 (16 years)

* The numbers in the parenthesis (   ) are t-statistics

4. At what price should the privatized firm be sold?

Inequality (2) says that the sale price Z should be maximized to improve the social welfare. Vickers and Yarrow (1988) suggest that a public tender sale should be chosen in order to allow the state to capture the full increase in value of the firm Z, and maximize social welfare. However, the evidences on actual privatization program take the form of gradual and underpriced sales as shown in Perotti and Guney (1993), Perotti (1995). The <table 2> also shows similar information.

But the opponents of privatization argue that the state sells the valuable assets of the nation too cheaply. For example, Sir Alan Walters (1988) remarks that it seems that no privatization can escape the accusation of giveaway.[2]

In case of initial public offerings (hereafter IPOs) of BT and NTT, there were significant excess demand and the investors enjoyed substantial capital gains. And privatizing authorities expressed their satisfaction on this phenomenon. This attitude of the government can be justified by the theory of information asymmetry. Grinblatt and Hwang (1989) show that a partial sale and underpricing by an informed issuer on the value of the asset is a reliable signal of high value and low risk of the prospect of the firm. Further, Branco and Mello (1991), and Perotti (1995) prove that the partial, discounted fixed price offering by the privatizing state may be necessary for separating equilibrium if there exist the policy uncertainty e.g., re-regulation, taxation, changes in regulated rates and entry deregulation.

Based on these theoretical arguments, Jenkinson and Mayer (1988) find that the privatized utilities of UK is more underpriced than the privately-held IPO companies. Perotti(1995) predicts that such firms as monopolies, protected industries will tend to be privatized with smaller fractions of shares and larger underpricing. Thus we can expect that formerly state-owned telcos are more underpriced in their IPO than in the IPO of privately held firms. But Dewenter and Malatesta (1997) present evidence indicating that it is not a general tendency for privatization to be underpriced to a greater degree than private IPOs.

In this situation, I will compare the underpricing of formerly state-owned telcos to the average underpricing of each country assuming that IPO returns for a given country are independently, identically distributed. Average initial return data for each countries are taken from Loughran, Ritter and Rydqvist (1994). The sample countries and their average initial returns are as <table 4>

The null and alternative hypothesis to be tested is;

H_0 : Initial return of SOEs is the same as that of private IPOs

H_a : Initial return of SOEs is different from that of private IPOs

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[2] Branco and Mello (1991)

<table 4> Initial Return of Selected Countries

Country	Initial Return	Country	Initial Return
Canada	5.4%	Mexico	33%
Chile	16.3%	New Zealand	28.8%
France	4.2%	Singapore	27%
Germany	27.1%	Portugal	54.4%
Italy	27.1%	the Netherlands	7.2%
Japan	32.5%	UK	12.0%
Malaysia	80.3%		

(source) Loughran, Ritter and Rydqvist (1994)

and test statistics, which is developed by Dewenter and Malatesta (1997), is
T =

$$\sum_c \sum_i (r_{ic} - \bar{r}_c) \div \{((\sum_c (N_c * \sigma_c)^2)^{0.5}\}$$

where the subscript c means country, i means the privatized firm within the country.

σ^2 is sample variance of the initial return

Under the null hypothesis, the statistics T has t-distribution with (N-1) and is asymptotically normally distributed. Resulting statistic $t = -0.0485 < t^*$, a trivial value. So we do not reject null hypothesis and conclude that the initial return on the privatization IPO is not different from that of private IPOs. Thus it is difficult to conclude that IPOs of SOEs are more underpriced than IPOs of private firms in each country.

5. To whom should the SOE be sold

5.1 Corporate Governance and Privatization

Boycko et al (1996) theoretically show that privatization will lead to effective restructuring of SOEs only if both cash flow rights and control rights pass from the government to private hands. Consistent with this statement, Shleifer and Vishny (1997) analyze the economic effect of privatization as follows: Corporate governance deals with the ways in which suppliers of fund to the firms assure themselves of getting a return on their investment. The bureaucrats controlling state firms have at best only an indirect concern about profits (because profits flow into the budget), and have objectives that are very different from the social interest. Nonetheless, they have virtually complete power over these firms, and can direct them to pursue any political objectives. State ownership is then an example of concentrated control with no cash flow rights and socially harmful objectives. Thus, the inefficiency of state firms is not all surprising.

In most cases privatization replace political control with private control by private investors. The result of the switch of ownership structure is typically a significant improvement in performance of privatized firms. But, if SOEs are privatized without the creation of strategic investors, agency costs of managerial control may rise even when the cost of political control falls. This outcome is not surprising, given that the controlling outside shareholders no longer exist in these firms, leaving managers with more managerial discretion.

It is widely used approach that the shares of the privatized telcos are preferentially allocated to the domestic small investors. Such countries as Japan and UK impose explicit limitation on the share fractions of telcos that a person can hold. This means that there may arise serious agency problem in the privatized telcos. If it is true, the shareholders of the privatized telcos are worse-off than the shareholders of private IPOs. Then, the widely diffused ownership of privatized telcos may be harmful to the welfare of the investors and the economy.

5.2 Welfare consequences and effect of ownership structure

If the reasoning of Shleifer and Vishny (1997) is correct, the potential exploitation of wealth of shareholders by the managers may be resulted in the long-term underperformance of the privatized telcos. So I summarize 1 year and 3 year holding period returns, net of initial return of each firm and market index return of respective countries, on 10 privatized telcos in <table 5>.

<table 5> Holding-Period Returns

Company	1 year return	3 year return
C&W	10.6%	-25.8%
BT	104.6%	-9.9%
STET	65.5%	218.5%
Telus	14.7%	16.9%
Tele Danmark	-48.1%	82.4%
Telekom Malaysia	89.7%	203.4%
Telmex	83.1%	94.15%
TCNZ	30.9%	40.4%
Singapore Telecom	-20.8%	-15.8%
KPN	3.8%	-14.9%

The table shows that there is no evidence that privatization of telcos leads to another inefficiency due to the agency problem. Moreover, on the performance of private IPOs, previous studies provide evidence of short-run price over-reaction and high initial returns but long-term underperformance relative to market index.[3] Thus, we can think privatized telcos outperform private IPOs.

In <table 5>, only two firms, Telmex and TCNZ have been sold to strategic investors. But the table shows that there are no significant differences in the holding-period return between the firms who have controlling shareholders and the firms who have widely diffused shareholders. I also tested the differences in the holding-period return using the stake of government in the first half of 1997, but there is no statistically significant evidence that the privately held stake is relevant to the holding-period return of the privatized firms. These results are consistent with Sappinton and Stiglitz (1987) who argue that the tender sale of SOEs may not be optimal if the potential buyers are risk averse or if there exists information asymmetry between vender and potential buyers

Thus, we may conclude that privatized telcos are better investment alternative than private IPOs and the welfare consequences of the privatization of state-owned telcos may be beneficial to the economy as a whole, regardless of the ownership structure.

6. Conclusion

I have provided a simple formal model to explain the social welfare consequence of privatization. Although the model is cast in an abstract cost-benefit framework, and the number of observations in the empirical analysis is limited, I find that privatization is a good measure to improve social welfare. This is true both for the west European countries that have suffered from the large treasury deficit, and for the developing countries that have suffered from chronic shortage of capital needed to construct necessary infrastructures.

I also find that the initial offering prices of privatization is underpriced, but it is not a general tendency for privatization to be underpriced to a greater degree than private IPOs. These results are inconsistent with the assertions raised by the opponents of privatization. Further, privatized telcos are good investment alternatives because long-term holding period returns of the privatized telcos outperform private IPOs. In sum, welfare consequence of privatization in the telecommunications industry is beneficial to the investors and the economy as a whole. This outcome holds regardless of the corporate governance structure.

<References>

Aggarwal, Reena and Ricardo Leal and Leonardo Hernandez (1993). The aftermarket performance of initial public offerings in Latin America. *Financial*

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[3] cf. Ritter (1991) for US, Ulhir (1989) for Germany, Keloharju (1992) for Finland, Mario (1993) for UK, and Aggarwal, Leal and Hernandez (1993) for Brazil, Mexico and Chile

Management 22, pp. 43-53

Allen, Franklin and Gerald R. Faulhaber (1989), Signaling by underpricing in the IPO market, *Journal of financial Economics* 23, pp. 303-323

Boardman, Anthony and Aidan R. Vining (1989), Ownership and Performance in Competitive Environments: A Comparison of the Performance of Private, Mixed, and State-Owned Enterprises, *Journal of Law and Economics*, April, 32(1), pp. 1-33

Boycko Maxim, Andrei Shleifer and Robert Vishny (1996), The Theory of Privatization, *Economic Journal* 106, pp 309-319

Branco, Fernando and Antonio Mello (1991), A Theory of Partial Sales and Underpricing in Privatization, mimeo

Choi, Seung-doo (1997), Divestiture Policy in a Cost-Benefit Framework, Asia Telecom 97 Strategic Summit, ITU

Dewenter, Kathryn L. and Paul H. Malatesta (1997), Public Offerings of State-Owned and Privately-Owned Enterprises: An International Comparison, *Journal of Finance*, September, pp 1659-1679.

Grinblatt, Mark and Chuan Yang Hwang (1989), Signaling and the Pricing of New Issues, *Journal of Finance*, June, pp. 393-420

Ibbotson, Roger G., Jody L. Sindelar and Jay R. Ritter (1988), Initial public offerings, *Journal of Applied Corporate Finance*, Summer, pp. 37-45

Jenkinson, Tim and Collin Mayer (1988), The Privatization Process in France and the U.K., *European Economic Review*, March, pp. 482-90.

Jones, Leroy, Pankaj Tandon, and Ingo Vogelsang (1990), *Selling Public Enterprises*, London, The MIT Press

Jones, Steven, William Megginson, Robert Nash and Jeffry Netter (1996), Share Issue Privatizations as Financial Means to Political and Economic Ends, mimeo

Keloharju, Matti (1993), The winner's curse, legal liability, and long-run performance of initial public offerings in Finland, Journal of Financial Economics 33, pp. 241-260

Levis, Mario (1993), The long-run performance of Initial Public Offerings: The UK experience, *Financial Management*, pp. 28-41

Loughran, Tim, Jay Ritter and Kristian Rydqvist (1994), Initial Public Offerings: International Insights, *Pacific Basin Finance Journal* 2, pp. 165-199

Megginson, William, Robert C. Nash and Matthias Van Randenborgh (1994), The Financial and Operating Performance of Newly Privatized Firms: An International Empirical Analysis, *Journal of Finance*, June, pp. 403-452

Megginson, William., Robert C. Nash and Jeffry M. Netter (1996), The Long Term Returns to Investors in Share Issue Privatizations, mimeo

Perotti, Enrico (1995), Credible Privatization, *American Economic Review*, September, Vol 85, pp. 847-859

Perotti, Enrico and Serhat Guney (1993), Successful privatization plans: Enhanced credibility through timing and pricing of sales, *Financial Management*, pp. 84-98

Ritter, Jay (1991), The Long-run performance of initial public offering, *Journal of Finance*, pp. 3-27

Sappinton, David E. and Joseph E. Stiglitz (1987), Privatization, Information and Incentives, *Journal of Policy Analysis and Management*, Vol. 6, summer, pp. 567-582

Shleifer, Andrei and Robert Vishny (1997), A Survey of Corporate Governance, *Journal of Finance*, June, pp. 737-783

Vickers John and George Yarrow (1988), *Privatization: An Economic Analysis*, Cambridge: MIT Press,

Vickers John and George Yarrow (1991), Economic Perspectives on Privatization, *Journal of Economic Perspectives*, Vol. 5, No. 2, Spring, pp. 111-132

Yarrow, George, (1986), Privatization in Theory and Practice, Economic Policy 2, April, pp. 324-364

Wortzel Heidi V. and Lawrence H. Wortzel, Privatization (1989): Not the only answer, *World Development*, pp. 633-641

The convergence virus: infecting media services with telecommunication bugs

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1. ABSTRACT

Telecommunications liberalisation has produced a 'hands on' approach by governments and regulators. There has never been so much regulatory activity. Free speech has rarely been an intense issue in telecommunications, because carriage and content were clearly separated. Broadcasting and the press, on the other hand, have benefited from long experience of politically and socially sensitive material, which has produced a 'hands off' approach. They generally enjoy the protection of international and domestic freedom of communication principles. Freedom of communication may be threatened by application of the high level of 'hands on' telecommunications regulation to content providers, by the broadcasters' loss of control of their own transmission, and by legal pressures on carriers to monitor content. The solution is to reject the content-carriage distinction, and recognise that carriage systems also require freedom of communication.

2. INTRODUCTION

This paper questions the assumption that all aspects of telecommunications are becoming less regulated.[1] It provides a broad summary of the many trends which pose a threat to the economic and social role of media in the environment of telecommunications regulation. It points to the danger that media content, the all-important justification for expanding networks and systems, may have less opportunity to flourish unless the new systems of regulation are made more sensitive to media freedoms.

The central point to be made is that the increase in telecommunications regulatory activity may infect on-line services. The 'bugs' are a number of regulatory, economic and legislative trends which may leave on-line services more weak and vulnerable than traditional media such as broadcasting and newspapers. This view is not fashionable.

Politically correct thinking, particularly in North America, is that telecommunications is less regulated than ever before, content is more free than ever before thanks to the Internet, and regulation of carriage does not affect content. This paper questions those comfortable beliefs.

3. THE INCREASE IN REGULATORY ACTIVITY

The current fashion is to regard nearly all Asia-Pacific countries as undergoing a process of deregulation and liberalisation. So they are, in the sense that virtually all telecommunications markets in the region are being opened to competition. Regulation is regarded as a quantifiable phenomenon. Thus there is discussion of 'more' or 'less' regulation, 'light' regulation and 'heavy' regulation.

Regulation is not a quantifiable phenomenon. It is a description for a very complex range of relationships, which are difficult to describe in objective terms. Most of the ideas about 'how much' regulation we have come from economists who like to quantify, and who do not have long experience of how regulatory schemes actually work. This paper is not concerned with regulation itself, or the ideological debates which it raises. It is concerned with regulatory activity, the amount of regulatory writing, talking, meeting and deciding. There are some crude indicators of regulatory activity, which suggest that it is increasing. From any overview of Asia and the Pacific, we need to exclude the US, which appears to have had a high level of regulatory activity and a large legal establishment surrounding the FCC for decades, probably since the Communications Act of 1934. For the rest of the region, these are some trends:

- The number of people engaged in regulatory activity is increasing. Twenty years ago, there were very few lawyers who would answer to titles such as 'communications lawyer' or 'telecommunications attorney.' Now we have specialist firms dealing with the area, departments within larger firms, associations of lawyers, journals and conferences[2]

- The number of communications regulators and authorities is increasing in most countries. We now have communications authorities, commissions and boards dealing with licences, spectrum auctions, competition regulation, content, multimedia development and other areas. Even where the purpose of an authority is industry development rather than old-fashioned regulation, it still adds to the complexity of the mix.

- The volume of laws is increasing. New telecommunications laws seem as plentiful as leaves in Autumn. It is difficult to find any country which has not enacted at least one new telecommunications statute in the last five years.[1] Not only do we have more laws, but they are being amended and replaced more frequently. Every new law tends to be more voluminous than its predecessor, to address this or that new 'challenge' in which governments and legislators are interested. One day soon, the idea seems to be, these laws will produce the state of perfect competition in telecommunications which will make further laws unnecessary. One is tempted to make a comparison with the millennial faith of European Marxist countries, that once perfect communism had come into being, the State would 'wither away' to leave everyone co-operating in perfect harmony without further need for regulation.

- The volume of standards and self-regulatory codes is increasing. Regulation abhors a vacuum. When government vacates an area, such as setting of technical standards or the regulation of media content, voluntary codes and standards usually move in to fill the void. Often governments require that industry take over its previous regulatory paperwork, and often there is a system of co-regulation, in which industry makes and applies codes in co-operation with a government or government agency. At the end of the day, codes and rules are still law. They still govern the activities and services of communications players. This is particularly relevant to media, where codes are expanding rapidly to address government concerns.

To summarise, telecommunications regulation is changing, probably for the better, but it is not disappearing. Regulatory activity is rising, but we are asked to have patience with this temporary phenomenon, which will subside once markets are fully liberalised. Governments are now more active than ever in managing the transition to competition. And there is no sign that governments and their agencies intend to abandon management of the competition. It would be naive to expect that the new regulatory activity, and the new regulatory players in public and private sectors and the professions, will naturally see any reason to keep out of content issues. After all, media content is interesting, growing and well-resourced territory.

4. THE 'HANDS ON' TRADITION OF TELECOMMUNICATIONS

With so much change and liberalisation taking place in communications, it is easy to overlook some things which are not changing. Specifically, the 'hands on' attitude of governments to telecommunications development remains unchanged. At the beginning of the century, politicians and governments were proud of the progress they were making in extending telegraph lines, and later telephone lines. Indeed, business and citizens expected governments to get on with the job as quickly as possible. In that era when, except in the US, only governments commanded the resources for the great network-building projects, there was no question of restraint or non-intervention. If they had taken a hands-off attitude, they would have been criticised for neglecting development.

By the year 2000, there may be few telecommunications networks still provided by government departments, as they have been for most of the century. However, the general attitude of government towards telecommunications development has not changed. We still have a 'hands on' culture in which policy-makers, bureaucrats and regulators intervene continuously. The major difference is that instead of directly controlling a government monopoly PTO, they make decisions and laws which leave the overt responsibility for actually delivering service to the private sector. But it is not a matter of setting up new structures and leaving them to the market. Supervision, monitoring and tax-gathering continue. It is important to remember that 'liberalisation' refers to market structures and economic freedoms, not to liberalisation of content or social freedoms.

The Thatcher government in Britain set many of the precedents and models for liberalising telecommunications which are now being adopted, directly or indirectly, in the Asia-Pacific region. It should be noted in passing that, despite its great influence in the region, the US could hardly provide models from its system in which the carriers were already privately-owned. Most Asia-Pacific countries were moving from government monopolies. The Thatcher government pioneered a double standard in communications policies. Liberal economic reform of telecommunications contrasted with a censorious approach towards electronic media. It sought to increase restrictions on indecent and tasteless broadcasts, and on broadcasts such as those relating to Irish political figures which were seen as seditious. It also introduced licence fees and auctions (since widely copied in the Asia-Pacific region) which had the effect of weakening the economic independence of broadcasters.

5. THE 'HANDS-OFF' TRADITION OF MEDIA

Traditional mass media such as newspapers and broadcasting have been accorded different regulatory treatment from telecommunications. Whatever the practice from country to country, the need for media independence has been recognised for a long time. There is a large international body of material which enshrines principles of diversity and freedom. The principles are recognised by governments of all political persuasions. They are recognised in many United Nations and international documents, including Article 19 of the International Covenant on Civil and Political Rights. They are also recognised in the constitutions, express or implied, of virtually every Asia-Pacific country. There are many different national interpretations of what freedom of communication means in practice, but there is little disagreement about the broad principles.

Newspapers and broadcasters have always looked to their delivery systems to support their freedom. Commercial and public broadcasters have relied on transmitter ownership to protect their economic independence, and to make the prospect of outside intervention more difficult. NHK in Japan is required by law to maintain its own transmitters; the public broadcasters in Australia struggled for decades to enhance their independence by gaining control of their transmitters from government agencies; and commercial broadcasters throughout the region have resisted planning schemes which would require them to abandon their own transmitters.

The independence of broadcasters has been further enhanced by the ability of international HF broadcasting to cross national boundaries in order to deliver information and entertainment which would be discouraged by national authorities. The Internet is not really the first global medium to defy national restrictions. HF broadcasting has been doing precisely that since WW2. Just as with the Internet currently, there are some areas of restriction. It is possible to interfere with HF broadcasting by jamming; but for most practical purposes HF broadcasting has been unrestricted. The effect on domestic services of an international medium which is difficult to exclude should not be underestimated. There is far less motive and inclination to restrict information, entertainment and even music which determined members of the audience can receive through the alternative international medium.

The obvious contrast is between the media independence, reinforced by factors such as these, and the 'independence' of content in telecommunications services. There is no large or widely-known body of principle to support that principle. It is true that in most countries of the region, the telephone, mail services and data services are subject to minimal controls. Anyone who made a phone call or posted a letter could assume that the content was a purely private matter. There were some exceptions. First, general laws dealing with sedition, vice and traditional crimes against person and property did lead to phone-tapping or mail interception in some cases. Second, there were a few countries which did regularly tap into the content and censor it.

The conventions and laws to protect telecommunications content are comparatively weak, because the main content was party-to-party voice conversation. Until recently, there has been no need to see telecommunications as a vehicle for news and information. It has been regarded merely as 'content', something almost incidental to the main game of infrastructure of networks. As media migrate from their own distribution systems to telecommunications networks, they are migrating to alien territory, which gives them no special recognition.

6. CONVERGENCE OR COLLISION OF REGULATORY CULTURES?

The two traditions, of 'hands on' and 'hands off' regulation may now be in collision, as media structures integrate with telecommunications. Some of the main trends are:

6.1 BROADCASTERS' LOSS OF TRANSMISSION INDEPENDENCE

Transformation of broadcasting services from vertically-integrated media controlling their own distribution into mere 'content channels' on communications networks. For example, the once-powerful TV networks so feared by politicians are losing audience and influence, to join the multichannel environment delivered by satellite and cable systems. Previously, broadcasters had direct access to their audience through their own transmitters. Satisfaction at seeing these Goliaths humbled should be tempered with concern that powerful independent sources of opinion and funding for programs are being fragmented.

6.2 NEWSPAPER DEPENDENCE ON ELECTRONIC DELIVERY CHANNELS

Newspapers large and small also controlled much of their own distribution through delivery to shops, street-sellers and homes. Now their content is migrating to on-line and multimedia channels, which need to negotiate access through the hierarchy of electronic delivery systems.

6.3 DIGITAL RADIO AND TV DEPENDENCE ON MULTIPLEXERS

Even in free-to-air broadcasting, digital broadcasting will see radio, the most direct and independent of all media, as well as television, multiplexed through concentrated, shared or centrally controlled digital transmission systems. Again, the broadcasters will lose some control of their distribution systems. This is more likely in countries which follow the European approach than in those which follow the US approach. The latter accords more significance to the traditional broadcaster.

6.4 CONTAMINATION OF THE COMMON CARRIER CONCEPT

Just at the time when the integrity of the common carrier as a neutral pathway for all traffic should be expanding to protect the new, more sensitive, media content, the concept is being questioned or, in the words of Rob Frieden, 'contaminated.'[4] As Frieden points out, some of the contamination has been caused by carriers themselves seeking to expand into media-related content. The powerful concept of a neutral common carrier, obliged to carry all messages, and protected from liability for doing so, has never been more important.

6.5 ISPS AND CARRIERS AS CENSORS

Legislatures and courts are seeking entities who can be held legally accountable for defamation, pornography, sedition and other forms of perceived wrongdoing. The current targets are the ISPs, but carriers may also be affected. This range of liabilities is a separate topic, but the attempts in various jurisdictions to hold ISPs responsible for 'offensive' content, whether under legislation or through industry code systems, raises the prospect that news media will be required to submit to the commercially conservative censorship of an ISP instead of taking their own chances about what they will print or broadcast. The insertion of another gatekeeper between the public and the content producer is likely to have a 'chilling' effect. Pornography is not the only battleground. An ISP which actively manages the content of its service may be found to have the liability of a publisher. The current trend is not to impose liability on an entirely passive ISP who merely provides carriage or a location through which defamatory material is disseminated.[5] Whilst the law, still in an inchoate state in most Asia-Pacific jurisdictions, does not appear to impose a new level of liability, in commercial terms the danger is that corporations running and ISP business and keen to avoid risk will impose tighter restraints on content than a dedicated news or information service would impose.

6.6 ISPS OR CARRIERS AS COPYRIGHT COLLECTORS

Copyright laws may turn telcos and ISPs into toll-collectors on the new information highways. The new WIPO copyright treaties[6], now being considered for adoption around the globe, can be used to impose onerous responsibilities on carriers and ISPs. In the conferences leading up to the treaties, carriers and ISPs sought decisive exclusion from responsibility for copyright infringements flowing from on-line distribution. They did obtain an agreed statement in relation to communication to the public that: 'the mere provision of physical facilities for enabling or making a communication does not in itself amount to communication within the meaning of this treaty or the Berne Convention.'[7] A lawyer's skills are not required to see how limited that interpretation is. There is a real possibility that national legislation implementing the treaties will make ISPs, or even carriers doing more than providing inert facilities, responsible for on-line copyright infringements. As with defamation law, the worst effect of this trend is not the actual liability, but the chilling effect of requiring carriers and ISPs to 'cover their backs' by imposing an extra layer of compliance on those who use their services.

6.7 AUCTIONS AND TAXES

Having gained a taste for massive restructuring through liberalising telecommunications, governments are starting to show an increasing interest in restructuring content providers: all in the name of economic reform. One example is the increasing imposition of taxes on media, such as auctioning of frequencies suitable for broadcasting, and also charging high fees for the right to broadcast at all. Then there is the prospect of auctioning channels for digital broadcasting, and rights to operate as digital broadcasting multiplexers. Even in the last century, taxation of newspapers would have caused uproar. When presented as an economic reform to allocate a scarce communications resource, the taxes attract little protest. Whatever the form of the taxation or auction, the ultimate effect is to siphon money out of content industries, and to increase the cost of providing media to the public.

7. CONCLUSION

If media are to be economically productive and socially creative, their special needs and special relationships with audiences must be respected. Network builders and policy-makers have unconsciously avoided the complexity of media issues by first making a crude distinction between carriage and content; and then saying that they are concerned only with carriage. The examples above have attempted to show that in reality it is impossible to ignore the impact which the regulatory culture of telecommunications will have on content providers.

Liberalisation and competition are just as important in the realm of ideas, news and entertainment as they are in the economics of carriage systems. It is difficult to point to any place or period in history where culture has flourished within a closely regulated environment. The countries in which creative content does not flourish are likely to find that they have built highways for exporting consumer and investment cash, to purchase the media output of other countries. How do we avoid crushing the media in the rush to liberalise carriage and build new telecommunications systems?

The first step is to abandon the modern form of the Manichean heresy which artificially separates carriage from content. In telephony the two have been legitimately separated. In broadcasting the medium and the message have been inseparable. As television, multimedia, videophony, broadcast radio and other services migrate to the fibre and satellite systems, it will be necessary for carriers of their signals to put more effort into protecting the integrity of the content.

Carriers and their advocates will need to put more resources into convincing courts, governments and legislators that restraint is needed when dealing with media distribution systems. This is no easy task. As already explained, there is a vast body of learning about freedom of speech and freedom of communication, but it has been confined only to the content side of convergence. Telecommunications, the spectrum, satellites and cables have been seen as raising only technical and economic issues, in which there are no limits to the growth of official power and regulatory bureaucracy. The reality is that media will flourish only when communications systems are suitable for their needs. Courts and governments must be convinced that genuine freedom of communication must include freedom for carriage.

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[1] The author is grateful to his colleague Mr Michael Hudson, Research Associate, Media and Telecommunications Policy Group, for valuable research on copyright, defamation and other areas incorporated in this paper.

[2] Some indication in the increase in lawyer numbers in Australia is provided in M. Armstrong 'And the Winner Is...?' *Telecommunications Journal of Australia,* 46(4) 1996. Estimates by practitioners suggest that in the East Asian region there are around 250 lawyers dedicated to communications issues.

[3] In Australia, the numbers of sections of Acts dealing with telecommunications in the successive waves of new laws are: 114 sections in 1975; 185 sections in 1989; 409 sections in 1991; and 920 sections in 1997.

[4] Rob Frieden, 'Contamination of the Common Carrier Concept in Telecommunications' *Telecommunications Policy,* 19(9) 1995, pp 685-697.

[5] *Stratton Oakmont & Porush v Prodigy & Sears-Roebuck* SC, NY, Oct 1995 is one of the celebrated US cases which supports this view.

[6] The World Intellectual Property Organisation Copyright Treaty (WCT) and Performances and Phongrams Treaty. Both were concluded in Geneva on December 20, 1996, and are open for signature at WIPO until December 31, 1997.

[7] Quoted and discussed in Australia, Attorney-General's Department and Department of Communications and the Arts, *Copyright Reform and the Digital Agenda: Proposed Transmission Right, Right of Making Available and Enforcement Measures,* Canberra, July 1997, paras 3.22ff, 4.69ff.

A Canadian Perspective on Global Telecom Liberalization; Strategies for a Small Fish in a Big Pond

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Abstract

This paper provides a Canadian perspective on the impacts and opportunities of global telecommunications liberalization, with particular emphasis on the WTO 1997 initiatives. An overview of the Canadian competitive environment and expected policy/regulatory developments to the year 2000 is given. The business challenges, strategies, and opportunities for a competitive carrier are explored; and some of the opportunities for global and Pacific rim partners are proposed. The network initiatives, plans, and business opportunities with one of the competitive carriers *(fONOROLA)* is provided as a case study of a successful smaller Canadian company's approach in this changing global environment.

1.0 The Canadian Business Environment

The World Trade Organization (WTO) negotiation agreements of 1997 undertook bold worldwide commitments on basic telecommunications liberalization. Of some 200+ countries in the world, the WTO agreement has 69 countries promising fair market access for basic telecommunications service, and 65 committed to enforce fair rules of competition through independent regulatory bodies or the equivalent. Some 40 developed countries are in the process of privatization of telecom and the introduction of competition. These global agreements mean that we face competition from the strong companies of at least these 68 other countries, and we can also compete directly in, or choose our business partners in these 68. Canada for its part committed to liberalize international wireline telecommunications by October 1998, with further actions which would include satellite and routing related restrictions eliminated by January 2000. The Canadian Government expressed its desire and objective to ensure that Canadians continue to benefit from world-class communications services at competitive prices provided by a strong domestic industry, while ensuring that Canadian telecommunications companies have secure access to foreign markets. However, these commitments and global trends to increased competition and deregulation appear to place pressure, indeed in some perspectives to diminish and threaten Canadian cultural autonomy and ownership as it relates to telecommunications. This is reflected in some controversy over maintained foreign ownership limitations for Canadian telecommunications facilities, and continued routing restrictions until the year-end 1999. Canada has largely implemented a competitive telecommunications environment nationally and with the USA in the early 1990s. The international sector is now the last frontier.

Although Canada is a relatively sparsely populated geographically vast country blessed with a challenging northern climate, its telecommunications industry is a healthy portion of the US$600 billion worldwide telecommunications service market, and its network and service capability form an attractive constituent of an integrated North American market. Within this market the long-distance sector generates approximately CAN $8 billion revenues, and is an attractive business for both domestic and foreign companies. Figure 1 provides a financial overview of the Canadian telecommunications services market.

Fig 1: The Telecommunications Services Sector in Canada

	1990	1991	1992	1993	1994	1995
Total Employment	142,157	129,621	120,217	126,910	127,529	144,551
Service Revenues	$15.0 B	$15.9 B	$16.5 B	$17.2 B	$18.3 B	$19.5 B
Total Assets	$31.0 B	$33.3 B	$36.2 B	$38.6 B	$39.3 B	$40.6 B
Profit Margin (%)	24.02	25.00	24.86	20.64	20.36	16.86

Source: Industry Canada Statistical Revue 1990-1995; published May 1997 ($ Canadian)

2.0 The Regulatory Outlook

Prior to the beginning of this decade, telecommunications services in Canada were provided by monopolistic enterprises. These companies, which later formed an alliance named Stentor, had their businesses regulated by an independent administrative tribunal, the Canadian Radio-television and Telecommunications Commission ("CRTC") which approved the prices they charged, the profits they made and the moneys they spent on capital programs. International telecommunications was not subject to regulation per se, but set by governmental decree and implemented by the CRTC. International telecommunications later came under the auspices of the CRTC in 1994. Local telephony and public long distance services were provided by the individual Stentor member companies, which were vertically integrated within established operating territories whose geographic boundaries roughly corresponded with that of Canada's provinces. Stentor member companies cooperated among themselves in the sharing of revenues for traffic between their respective territories, and in the design, operation and management of a national long distance network as well as in the implemention costs of these national communications links. The Stentor member companies were permitted to operate as they wished as long as they fulfilled their universal service mandates regarding the support of service in rural and remote areas and other regulatory requirements, at least until the arrival of competitors. Numerous smaller regional independents have existed since the late 1800's, as well as significant private and data telecommunications providers which were not interconnected to the public telephone network. The largest of these, CNCP Telecommunications, had its origins from the railways telecoms; and was a predecessor to Unitel which has now evolved through ownership changes to AT&T Canada, one of the larger competitive carriers. Industry Canada and the CRTC have introduced measured competition in stages into this vertically integrated monopoly environment.

2.1 Resale Competition

With the model of competition in the United States, aggressive entrepreneurs in Canada began to challenge the status quo in the late 1980's. After challenges before the cabinet of the Federal Government these companies eventually won the right to operate. As a result of these entrepreneurial moves, in 1990 the CRTC began its own 'long march' to open up the telecommunications sector to increased competition, with the blessing of the Federal Government. The CRTC first allowed the full resale and sharing of switched voice and data services for domestic long distance traffic. Then in 1991, they permitted the resale of international switched services and allowed those same resellers the ability to route international traffic over leased international private lines. Only the Stentor member companies were left out of these resale markets due to a recognition by the CRTC of both their market dominance and the significant revenues their switched voice telephony provided the monopoly overseas carrier, Teleglobe Canada Inc. ("Teleglobe").

Resale proved to have business limitations. It does not allow a competitor to completely control its underlying network costs. The underlying carriers, which at this time consisted primarily of the Stentor members from which the competitors leased facilities or bulk services, could easily engage in a margin squeeze by aggressively reducing the rates charged for their own competitive switched services while leaving the rates for bulk telecommunications services leased by the competitors at higher levels. Significant pressure to expand the scope for facilities-based competition was placed on the Canadian government.

2.2 Facilities-Based National Long Distance Competition

In June 1992, the CRTC ruled that it would be in the public interest to permit open, facilities-based competition for the supply of domestic long distance services. This decision has been called the true start of long distance competition in Canada. The CRTC mandated the Stentor member telephone companies to upgrade their local and long distance switching networks to accommodate Equal Access (also known as 1+ dialing) by 1994 which enabled customer selection and pre-subscription of the preferred inter-exchange carrier. These rulings also allowed open market entry (as opposed to a market duopoly), proscribed a system of fees that competitors would have to pay to Stentor members to fund continuing low local telephone rates, and ordered the tariffication of all interconnection arrangements.

As a result of the CRTC's decision, long distance rates tumbled relatively faster and farther than experienced in the United States. Competitive market entry proliferated, and consumers were suddenly faced with many choices for their long distance services. At one time, more than three hundred resellers were registered with the CRTC. In the middle of all this, the

Federal Government finally passed into law its long-awaited Telecommunications Act, which set out the policy of the Government with respect to telecommunications in Canada, awarded greater powers to the CRTC in discriminatory matters and deregulation, and most importantly for the business, codified foreign ownership limitations.

In the period after the implementation of Equal Access in 1994, a number of the resale companies did not survive and went bankrupt or were acquired; and their customers were absorbed by the stronger players in the industry. Today, the over one hundred surviving active companies (both resellers and facilities-based carriers) comprise also the four principal competitors to the Stentor members: AT&T Long Distance Services Company, which has both an equity infusion from AT&T Corporation in the United States as well as a license to market AT&T products and services in the Canadian market; Sprint Canada, which also has an equity investment from Sprint Communications LP in the United States as well as a license to market Sprint products and services in Canada; *fONOROLA* Inc., an independent company with limited foreign investment from venture capital funds and commercial banks; and ACC TelEnterprises Inc., a wholly-owned subsidiary of ACC Corporation based in Rochester, New York. The first three companies have either built or will be constructing fibre-optic networks in Canada in order to provide competition with Stentor's existing long distance facilities. The fourth, ACC, is a pure reseller.

2.3 Local Competition

Not content to open just the long distance market, in September 1994 the CRTC proscribed in principle the liberalization of the local telephony market. In May of 1997, the general terms and conditions of entry into the local telephony market were established, thus formally opening the local sector to competition by 1998. The CRTC has indicated that it will hold everyone in the industry, including the incumbent carriers, to the implementation date of January 1 1998, while recognizing that considerable work remains to be done in the areas for example of Local Number Portability, the establishment of appropriate technical interfaces between the incumbent local exchange carriers and the new entrants, and the appropriate procedures to allow for the proper marketing of local and long distance services in this new environment.

2.4 International Competition in October 1998

While competition appears to be breaking out everywhere in Canada, there remains one holdout sector of the industry: "international telecommunications". Currently in Canada international telecommunications facilities and services are supplied by one company, Teleglobe, by virtue of policy decisions taken by the Federal Government and the discretionary power it has in granting licenses for submarine cables which land on Canadian shores and the licensing of satellite systems and spectrum. International telecommunications in Canada were operated by private foreign companies for some time in the early part of this century until the Federal Government expropriated (puchased and nationalized) the Canadian international assets of Canadian Marconi Company and C&W to form the Canadian Overseas Telecommunications Company (COTC). This company later changed its name to Teleglobe and was privatized by the Government in 1987 with an 'exclusive mandate' to run all of Canada's international telecommunications for five years, with a renewal for another five years subject to the fulfillment of performance guarantees. This mandate was renewed in 1992 on the force of the arguments which concluded that Teleglobe had indeed fulfilled its performance guarantees. However, in extending this mandate for another five years until April 1997, the Government stated that it would review Teleglobe's mandate three years later, in 1995. This was done via a public proceeding but no decision was taken on the basis of this proceeding, due at least partly to the potential effects of the WTO negotiations on basic telecommunications services. In WTO Canada committed to open the international sector to competition by October 1998.

2.5 Trade and Telecommunications Services

During the time that the CRTC was introducing competition to the Canadian telecommunications services industry, trade negotiators were beginning to consider adding telecommunications services in discussions on the North American Free Trade Agreement (NAFTA). Services of all kinds were being negotiated amongst the three parties at the table, but telecommunications remained one of the most controversial due in part to Canada's desire to avoid any discussion related to cultural domains and to maintain Canada's restrictions on foreign ownership of the telecommunications industry in Canada. Mexico was also refusing to budge on the issue of foreign ownership beyond its statutory level of 49% for TelMex, their principal operator of telecommunications services. The result was that the three countries could only find common ground with respect to free trade of enhanced telecommunications services. Basic telecommunications services, defined principally as facilities and voice services, are not covered in the agreement. The three sides agreed to explore the inclusion of basic telecommunications services at a later undefined date. However, events within the WTO have now eclipsed the NAFTA, leading to a much more comprehensive agreement than first envisaged between Canada, the United States and Mexico.

The WTO negotiations concluded in 1997 with precedent-setting agreements which redefine how telecommunications markets will be managed. Trade principles and WTO dispute settlement mechanisms will now be applied to basic telecommunications. Not only did individual countries agree to open up their telecommunications markets, but they also agreed to a number of trade principles which would ensure the same regulatory treatment for foreign firms as domestic firms. This agreement is significant because it ends the previous practice of nurturing national champion companies to the detriment of foreign firms wishing to enter the same market. It ends any form of regulatory discrimination, favourable interconnection terms for domestic firms over foreign firms, and the practice of regulating an industry as a department of a national government. Legitimate policy choices will still be adhered-to but now under a much different framework.

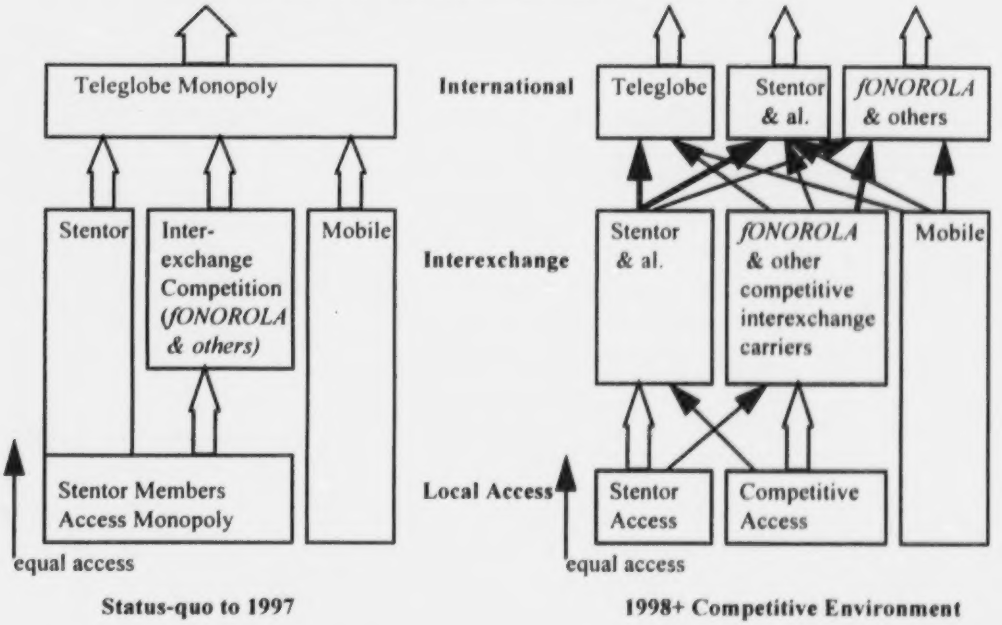
So what does the WTO mean for Canadian firms? In the domestic long distance and local telephony markets, not much at all. Canada already has an independent regulatory agency, had opened up competition in both market sectors and requires all competitors to adhere to non-discriminatory interconnection terms and conditions. The rates charged by the new competitors are entirely de-regulated and Stentor is expecting similar treatment to arrive in 1998. However, for international long distance there is an impact. Teleglobe's exclusive mandate will formally end on October 1 1998. The Government will also be open to awarding licenses to any company, regardless of ownership, to land submarine facilities on Canadian shores as of the same date. Traffic routing restrictions, whereby the Government requires all traffic leaving and entering the country to be routed over Canadian facilities (the definition of which is yet to be determined), is scheduled to be relaxed at year-end 1999 although pressures are mounting to end this sooner. In October 1997 the CRTC initiated a public hearing to determine the appropriate licensing conditions that will be applied to all international market participants. This hearing is currently in progress, with final comments accepted until 13 March 1998. A decision is expected sometime in Spring or early Summer 1998. Companies in Canada now have the planning signals and policy direction they need to prepare for their entry into the international market in competition with Teleglobe.

2.6 The Resulting Industry Structure

This policy and regulatory activity has therefore evolved an industry structure which was dominated by monopoly interests at the beginning of this decade, and implemented an environment with open competition at the local, national inter-exchange (long distance), and international levels. It is important to note that the CRTC has introduced competition into the Canadian telecommunications market in a manner that can only be described as deliberate and managed. The Commission has in each case taken all the necessary steps to introduce competition into a former monopoly market while ensuring that all the appropriate safeguards were put in place before moving on to the next step. This has meant less of a free-for-all market structure, market stability for new entrants, and has resulted in the introduction of financially stable competitors into the Canadian market. Within this structure, the facilities-based operating companies are subject to Industry Canada policy and a CRTC regulatory regime. Foreign ownership and control is restricted to a maximum of 46.7% of facilities-based carriers. Specific "grand-fathering" provisions allow majority ownership by GTE (a USA company) in two regional operating telephone companies in British Columbia and Quebec serving over 10% of the total Canadian market. There is also an increasing trend of foreign ownership in the other Canadian competitive carriers to the extent where foreign participation in Canadian telecommunications as a whole exceeds the level prevalent in most other countries.

Figure 2 shows the emerging competitive industry structure in Canada.

Figure 2: Canadian Telecommunications Industry Structure


Teleglobe Monopoly
Stentor
Inter-exchange Competition (ƒONOROLA & others)
Mobile
Stentor Members Access Monopoly
equal access
Status-quo to 1997
International
Interexchange
Local Access
Teleglobe
Stentor & al.
ƒONOROLA & others
Stentor & al.
ƒONOROLA & other competitive interexchange carriers
Mobile
Stentor Access
Competitive Access
equal access
1998+ Competitive Environment

3.0 Technical and Market Challenges

There are unique challenges provided for smaller countries and emerging carriers by the international trends towards high capacity submarine fibre-optic transmission projects, and the consolidation of business control within a limited number of consortia with ownership by dominant carriers having a large home-market base. This is particularly evident in Canada with consequent impact on Canadian presence and viability in a global market.

3.1 International Facilities

The carriage of telecommunications minutes is a commodity business with declining costs and prices; but the cost of market entry as a facility based competitive carrier is capital intensive. New global fibre-optic systems have capacities in the range of 10 to 40 Gigabits/second, with system costs in the order of US$300-700 Million for a trans-Atlantic linkage for example. Only companies and nations which are able to competitively terminate or transit large amounts of traffic are likely to play a significant global role. Yet it is a market reality that these new systems tend to terminate where the large "sources" and "sinks" of traffic are located. It is critical for a carrier, and a country, to have participation in new systems (particularly international submarine cable systems and national fibre builds) since the cost/unit of each new generation of systems is significantly lower. A decision not to invest in successive generations of systems, or an inability to participate (whether due to financial, political, or regulatory reasons) will result in being frozen out of the advantages of cost reduction and efficiency, and eventual uncompetitiveness for the carrier and the country as a whole. It is critical for a national policy and companies to attract such new ventures to their shores with interconnection to national systems; this brings traffic flows and opportunities to build a central position in global telecommunications.

New service markets (Internet and image/broadband) are enabled by these bandwidth and cost trends. Many related national markets may not prosper without the benefit of future fibre-optic networking on a global scale (e.g. film production and post-production, animation, financial and data processing, and the Internet content industry). Consequently the implementation of national and international fibre networking is recognized as a priority objective in many private and government driven "Information Highway" initiatives. Within Canada, the impact of these infrastructure trends is reduced costs and prices to customers, but increased barriers-to-entry for new entrants. This may imply a need to promote all new entrants domestically in order to entrench a competitive global environment going forward.

Certain countries have geographical advantages due to "short routes" between major markets, good national infrastructure, or geographic positioning which can be parlayed into a system hub beyond the normal expectations of regionally sourced or terminated traffic (e.g. Canada, Hawaii, Singapore, UK/Ireland). Canada and the facilities-based Canadian carriers have recognized this synergy between international systems, national systems, and geography. Several Canadian carriers and networks are well positioned by design to provide complete North American connectivity and market access, as well as overall cost-effective global submarine fibre-cable routing and termination utilizing the advantages of the reduced distances provided by "great-circle" cable routings between continents.

3.2 Global Consortia Dominate Traffic Flows

In the 1990's a trend to consolidation in international markets was attested by a series of joint service agreements, equity exchanges and joint investments between groupings of dominant carriers. The objective was increased capability in the marketing and provision of international one-stop-shopping services to global corporate clients, however an additional benefit was the protection of their domestic customer base and reduction in competition between the parties within a specific consortium. The share of global traffic controlled by the largest four consortia has grown from 41.5% in 1990 to 57% by 1994, with this trend still continuing. Furthermore, privatization and worldwide relaxation of foreign-ownership restrictions is leading to the increased presence of well-capitalized foreign corporations casting their eyes on North American, European, and Asian markets in an effort to expand presence and revenues in markets outside of the home market they dominate, and which in some cases is shrinking if they are the incumbent monopoly. The shake-out and mergers in the telecommunication market will likely continue well into the year 2000. A possible scenario is the stratification of the telecommunications market into four groupings:

- a limited number of "super-carriers" which operate on a global basis, offering premium seamless networks and services.
- carrier's carriers and independents, specializing in high-volume low-margin transport and wholesale.
- regional and national specialists, who have significant market and understanding of the local customers (and make good exclusive partners for the consortia, or customers for the wholesalers).
- niche operators, by activity or customer.

Canadian companies today are largely confined to the last three categories. The major consortia are all owned and controlled by entities with no significant Canadian presence beyond regional distribution and market access roles. While the three largest Canadian telecommunications companies are aligned with consortia (AT&T Canada with Worldpartners, Stentor with Concert, and Sprint Canada with Global One), or are at least partially owned by founding members, the other emerging companies are unaligned. The Canadian telecommunications companies with North American market access and excellent network interconnectivity are well placed to contribute to a leading global role and place Canada on the main-lane of the global information highways with overseas partners. However, this will likely occur in an environment of increased (and cut-throat) competitive action worldwide, culminating in further industry consolidation over the next 5 to 10 years.

4.0 Capitalizing on the Opportunity

The global and Canadian market structures are changing, with the competitive freedom to choose business models and partners on a case-by-case basis, in at least the WTO countries. Traditional international interconnection mechanisms and associated accounting rate mechanisms are complemented by the use of resale, ISR, and cost-oriented settlement rates, termination charges, and interconnect fees; all of which are in use in Canada. "Bill & keep" and modified cascaded settlement has been a standard way of operating in data networks, the national environment, and resale for decades, but only now is being accepted in international telephony. The opportunities for entering the international market in this environment are varied, with progressively increasing commitment and business benefit.

A Canadian entrant wishing to enter the liberalizing international domain has at least the following business options as of January 1998:

1. Buy Gateway Access Service: interconnect to the gateway of another existing licensed Canadian international carrier (the status quo).

2. Resale: use spot market purchase and sale of minutes. Many wholesalers/resellers have no international infrastructure and the traffic will gravitate to facility based carriers. Short term deals proliferate, and there have been quality considerations.

3. ISR (Leased-line resale): ISR is a margin play between IPL rates and the Gateway or resale Minutes rates. It requires minimal commitment and capital. However, as a "rule-of-thumb" several months' lease could buy the equivalent capacity ownership in the same system.
Canada has always had one of the most open ISR environments with an extensive list of countries.

As of October 1, 1998 the following additional business options are available:

4. Operate as a facilities-based carrier: receive an "international carrier license" under the new Industry Canada and CRTC procedures, and participate in facility acquisition projects and acquire underlying capacity to support operating agreements. Become a satellite and/or cable system signatory (such as INTELSAT or submarine cable C&MA or IRU). This opens the options to acquire wholly-owned or half circuits, in both carrier or private cable systems.

For well positioned facility-based carriers there is an opportunity to initiate and lead projects, create or participate in Joint Ventures for new systems, attract partners and organize funding. In particular Canadian entities with a complete North American perspective and market access can provide a valuable contribution to other partners which goes beyond purely Canadian interconnectivity.

5.0 A Canadian Industry Case Study

The approach taken by Canadian governments and regulators has been an introduction of managed competiton in progressive phases over 10 years, starting from simple resale and sharing and now leading to facilities-based competition at the international level. Numerous companies successfully entered the liberalized domestic (within Canada) and trans-border (Canada-USA) long-distance business. One of these, *fONOROLA* Inc., is offered as an exemplary case study in the development of a business through this unfolding telecommunications liberalization. Although *fONOROLA* is not unique in the ranks of successful Canadian carriers, it illustrates a company business development strategy which takes advantage of each stage in Canadian liberalization, from initial operation in simple resale in 1989, to the progressive establishment of facilities-based operation.

A partnership with Canadian National Railways in 1995 gave fONOROLA access to some 32,000 kilometers of right-of-ways. This, and other facilities partnerships has enabled the Company to undertake the construction of over 12,000 kilometers of OC-192 fibre facilities in both Canada and the USA, of which over 5,000 kilometers are already in place. Figure 3 charts these developments. Figure 4 illustrates the resulting network commitments.

Figure 3: *fONOROLA* History of Growth

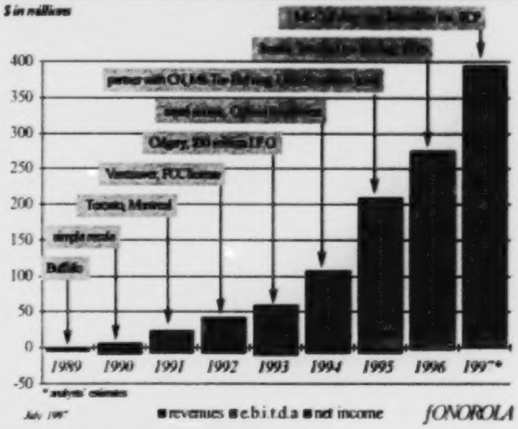
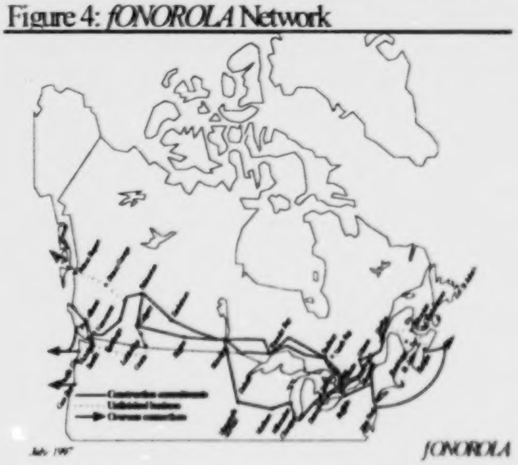


Figure 4: *fONOROLA* Network



fONOROLA's business decisions can be summarized as:

- a primary initial focus on the corporate and wholesale markets, resulting in an ability to keep SG&A (sales, general and administrative) expenses tightly controllable and coupled to revenues (at approximately 20% of revenue, among the lowest in the industry). This focus is a factor contributing to survival in the initial resale market environment, which is characterized by abundant competition and diminishing margins.

- an aggressive implementation of facilities infrastructure, primarily in order to reduce operating costs. These have been taken with a longer term view of a cohesive trans-national North American network.
- establish operations and presence in both the Canadian and USA markets, which provides access to increasing volumes of traffic.
- a business approach involving partnering and joint ventures, which minimizes risks and excessive capital outlay requirements while taking advantages of synergies between companies.
- awareness and exploitation of the opportunities created by governmental and regulatory policy at each step.

fONOROLA is one of the Canadian companies which sees itself as being advantageously positioned to take advantage of the international business opportunities created by 1998 WTO implementations and the Canadian commitments. *fONOROLA* has built an advanced telecommunications network consisting of owned and leased inter-urban fibre-optic systems, digital switching centres, and real-time network management systems which can bridge the largest volume telephony and data routes in the world; from North America to Europe and from Asia to North America. The Company is poised to capitalize on international liberalization with its networks already connecting Canada to the heavily-populated eastern and mid-western regions of the USA. The establishment of international facilities-based competition in Canada in October 1998 opens several new service and strategic business opportunities with international partners:

- a non-aligned carrier business partner for telephony, data, and value-added service Operating Agreements, with the ability to provide price-competitive access to both US and Canadian markets.
- bilateral and multi-lateral carrier and facilities arrangements (IRUs, transit, traffic exchange, international circuit implementations).
- ability to participate in global initiatives involving international facility termination in North America, and to provide a seamless high capacity digital interconnectivity across the continent.
- delivery of *fONOROLA*'s North American traffic for global termination on overseas carriers' networks.

6.0 Summary and Conclusion

The Canadian telecommunications environment has been taken in managed stages from a closed monopoly environment a decade ago, to an open competitive environment in 1998, conforming with WTO accords with respect to market access, fairness and transparency of regulation. Within this tempestuous environment almost one-half of the entrants survived, one-half have left the business, while a handful have prospered significantly despite initial years of financial and business challenges. The entire industry is growing year-on-year during this time in absolute revenues terms, even though the cost/unit of service has decreased; implying both the consumers and service-providers have gained value. The Canadian Communications Industry index (a stock performance measure compiled by Industry Canada) has increased at an annual compound rate of 11.49% over the Jan 1993 to Dec. 1996 term, implying that the investors have also profitted even with both winning and losing industry selections included in the index. Canada provides a "living laboratory" demonstration of the advantages of liberalization and the managed introduction of competition.

References:

1. *TeleGeography* 1996/97 edition, & 1995 edition
2. *"A Bright Outlook for Telecommunications"* by Sam Paltridge and Dimitri Ypsilanti, *OECD Observer* April/May 1997

3. *Statistical Review 1996/1997 Edition*, Industry Canada, Spectrum Information Technologies and Telecommunications Sector
4. The Canadian Institute: International Telecommunications; June 1997- *"Opportunities and Challenges in the WTO Regime: A U.S. Perspective"* by Kelly Cameron International Bureau FCC
5. ibid.- *"The WTO Agreement in Telecommunications: A Canadian Perspective"* by Michael Tiger, Industry Canada
6. ibid.- *"International Telecommunications; Opportunities and Challenges in the New WTO Regime"* by Tapio Knuutila, *fONOROLA*
7. *The Focus Report* Vol. 6 No 3 June 1997; published by The Government Source, Ottawa Canada
8. *The Financial Post*; Aug. 5 1997 pp. 21 report on *fONOROLA* Inc. by Ian Karleff
9. Annual Reports *fONOROLA* Inc. 1995, 1996
10. Quarterly reports, press releases of *fONOROLA*, 1995, 1996, 1997
11. http://strategis.ic.gc.ca; Canadian Industry Statistics Publication date 28/4/97

The WTO Basic Telecommunications Agreement: Does a Rising Tide Lift Those Without a Boat?

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ABSTRACT

This paper locates the recent WTO Basic Telecommunications Services Agreement in the context of "globalization", free trade, and developments at the WTO. It raises questions about possible unintended adverse consequences of the Agreement for developing nations, and suggests policy approaches to ameliorating some of these impacts, which might otherwise lead to adverse political and social reactions.

On February 15, 1997, 69 members of the World Trade Organization announced that they had entered into an Agreement on Basic Telecommunications Services (the "WTO Agreement") to increase competition in this sector. What can developing nations, and especially the poorest of the poor, look forward to from this Agreement? Will the expected "rising tide" lift them up along with the obvious beneficiaries – developed countries, established global carriers and suppliers, and large business users of telecommunications services? Or is it "lots of jam today" for the winners, and "a little jam tomorrow" for the rest? More importantly, will the WTO Agreement exacerbate pre-existing political, social and economic stresses, adversely affecting the continued movement towards international free trade?

1. The Context of Globalization

To understand the implications of the WTO Agreement, it is necessary to see them in their larger context – a broad, world-wide post-World War II economic, trade and political trend captured in the phrase "globalization".

Globalization is said to represent a huge opportunity for countries at all levels of development. The 15-fold increase in trade volume over the past four decades (compared with a sixfold increase in production), is considered one of the most important factors in the rise of living standards across the globe. Now, with a fresh wave of market-opening initiatives transforming economies, forecasters predict global economic growth of 3.5% to 4% for the next two decades. At this rate of growth, world production of goods and services will double by 2020.[3] Developing countries now account for about 25% of world trade, compared with 20% a decade ago.

With this transformation has come a new economic, social and political order. In every part of the globe, governments are embracing liberal economic policies. Multinational companies are accelerating the exchange of innovations and people across open borders. Investors are insisting that governments and companies open their books and practice transparency in their operations. The domain of international rule-making and policy coordination has expanded, and the notion of "domestic" policy has assumed a narrower focus, especially in the economic area.

Advances in information and transportation services and networks are forging ever stronger links between countries, regions, cities, and peoples, giving rise to a global middle class that, in the words of Stanford University Professor John Meyer, shares "similar concepts of citizenship, similar ideas about economic progress, and a similar picture of human rights."[4] It is this social transformation, however, that causes stress lines with traditional cultures, governmental structures and religions.

In social terms, it is disingenuous to behave as if market-opening, continuing international economic integration, and trade liberalization are always painless. Some people will be displaced through the resource allocation shifts that occur as a result of these processes. While the efficiency gains from specialization through trade stimulate economic activity and create jobs, ultimately making up for what may be lost through job displacement, managing this transition, and dealing with the distributional consequences of change, is a fundamental challenge for governments and participants.[5]

Communications and information technologies have profound impacts not just on economies, but on politics, societies and cultures. Pressing forward without an appreciation of these impacts may render planned developments vulnerable to delay or even denial based on both economic and non-economic factors. Reactions to free trade, globalization and information technologies can result in political backlash in some countries whose traditions and policies are inconsistent with such trends.

An example of this is the an article from the New Straits Times entitled, "U.N. Review Necessary, Says Dr. M." in which the Prime Minister of Malaysia, Dr. Mahathir Mohamad, reportedly called for the United Nations to review and alter the 1948 United Nations Universal Declaration of Human Rights because it had been "formulated by the super powers, which did not understand the needs of poor countries."[6] The West's insistence that developing countries conform to their high ideals on human rights is "oppressing" he said, and should not remain "a common standard of achievement for all people and all nations." Will such viewpoints be further fed by aggressive globalization? Should the spirit of globalization be totally insensitive to such concerns? And if it is, what will be the consequences?

2. Trade in Services/GATT/WTO

Since World War II, round after round of international trade negotiations had shelved or ignored the problems emerging from dealing with services, especially those based in new technologies. At the insistence of the United States, the case of services trade was brought under an umbrella agreement considered by the GATT at its September 1986 meeting at Punta del Este in Uruguay. Many developing countries still voiced reservations to the liberalization of services, as Pipe describes:

> *"The introduction of trade in services into a GATT negotiation was viewed with caution, if not opposition by many developing countries. This was because trade officials from developing countries recognized that many services industries were far less advanced than those of industrial countries, and consequently opening markets to foreign services could retard the growth of indigenous capabilities, result in unwanted reliance on foreign service providers as well as exacerbate balance of payments problems."*[7]

In the end, however, these arguments were not as persuasive as a case for the benefits of liberalization of international transactions in services, citing efficiency enhancements through improvements in allocative and technical efficiency, expansion of consumption possibilities, increases in foreign investment, improvements in access to knowledge, and increases in productivity of factor endowments as the end-results of the process.

In total, 116 nations participated in the Uruguay Round negotiations. In December of 1993, the Uruguay Round concluded, having achieved a new legal framework for international trade in services that would be administered by the newly created World Trade Organization (WTO). Known as the General Agreement on Trade in Services ("GATS"), it represented a major achievement for the Uruguay Round. Consisting of a set of rules and disciplines applying to all WTO members and a schedule of specific commitments, GATS provided a framework for trade in services that embraces both Most Favored Nation (MFN) and national treatment/non-discrimination principles.[8] According to former U.S. Trade Representative official Jules Katz, a senior negotiator in the Uruguay Round, "The WTO was created in the image of the U.S. We are responsible for its strengths and weaknesses."[9]

As of January 1, 1995, the WTO became the legal and institutional foundation of the multilateral trading system. The WTO's overall objective is to expand trade under conditions of transparency and progressive liberalization, as a means of promoting economic growth of all trading partners, and, in particular, of developing countries. Any agreements and general principles of the WTO extend to all WTO members on a non-discriminatory basis through the "most favored nation" and "national treatment" principles, unless otherwise excepted in a scheduled exemption.[10]

3. The WTO Basic Telecommunications Agreement

Negotiations on basic telecommunications services commenced with the "Uruguay Round" General Agreement on Trade in Services, completed in April 1994, which contained a GATS Telecommunications Annex, and concluded with the WTO Agreement covering 69 countries representing nearly 95 percent of telecoms revenues worldwide.[11]

The WTO Agreement covers all public and private telecommunications services that involve the end-to-end transmission of customer-supplied information. The signatories also agreed that both basic telecommunications services provided over network infrastructure and those provided through resale (over private leased circuits) would fall within the scope of the Agreement. As a result, the market access commitments cover not only the cross-border supply of telecommunications but also services provided through the establishment of foreign firms, or commercial presence, including the ability to own and operate independent telecommunications network infrastructure.

The 69 countries which committed to various levels of market opening must allow suppliers of telecommunications services from other WTO members to provide services by any of the modes included in their schedule, without evaluating whether or not that member provides a similarly open market. The most significant implication of this will be the requirement to permit telecoms operators based in other WTO member countries to build network infrastructure and compete in the national market on an MFN basis. Entry can no longer be restricted to those countries which provide reciprocal access or are parties to bilateral agreements.

Newspaper headlines in Europe and the U.S. trumpeted that the WTO "deal" will cut prices heavily, break-up existing telecom monopolies and open national markets. Much of the initial U.S. public media reporting of the Agreement focused on the benefits to consumers. According to Reed Hundt, then Chairman of the Federal Communications Commission, intensified competition resulting from the Agreement is "great news for American consumers". "Today, the average cost of an international call is almost $1 a minute," Hundt said, but "the process advanced by this agreement will, over time, reduce that price by 80 percent."[12]

American consumers and companies spend about $14 billion on international telecommunications services each year. That includes private data lines for computers, as well as old-fashioned telex and even telegraph services. A vast majority of the traffic, though, is plain old telephone service. The price of those calls is determined to a great extent by what the foreign phone company – often owned by a government – charges for completing them. And so, the per-minute rates vary greatly from country to country and are often artificially high. Developing countries defend such high settlement rates as necessary to help finance the construction of telecommunications networks within their borders, but Americans see higher rates as trade barriers. "There is no reason that international calls should be any higher than domestic calls that cover the same distance," said Diane Cornell, chief of the telecommunications division of the FCC's international bureau.[13]

Rather than hand traffic to another telephone company in the middle of the ocean for a fee, companies can land their own lines in a foreign country, and pay no settlement whatsoever. Although the WTO agreement does not eliminate the old accounting system, the fact that 52 countries agreed to open their markets to international competition may make it increasingly irrelevant.[14] The deal could cause global telephone rates to fall by 15 percent in the three of four years after the pact goes into effect, estimated Tom L. Elliott, a partner at Arthur Andersen, the consulting firm. "Over a 10-to-12 year period, a trillion dollars could be saved by consumers world-wide," he said.[15]

4. Impacts of Globalization

Since developments in the telecommunications sector must be seen in the context of the impacts – both positive and negative – of globalization, it is useful to look at recent commentary on globalization identifying possible areas of concern.

In recent years, there has been a stream of critical literature from the social left, decrying developments in free trade and globalization. However, the issue of negative impacts has now gone more mainstream, for example, in a recent book by Dani Rodrik of the Institute for International Economics entitled, "Has Globalization Gone Too Far?"[16] Rodrik, an economist, concludes that globalization is beneficial on the whole, but that it can impose significant costs on some groups within each country. Policy makers, he asserts, must respond by ensuring that international economic integration does not contribute to domestic social disintegration. Rodrik identifies three sources of tension between the global market and social stability.

First, globalization makes the services of large segments of the working population more easily substitutable across national boundaries, and therefore transforms the employment relationship. Second, globalization engenders conflicts over social norms and the institutions that embody them, both within and among countries. Third, globalization has reached a stage at which it has become exceedingly difficult for governments to carry out one of their central functions: the provision of social insurance.

Rodrik does not believe a return to protectionism is the answer. However, the answer he offers, that external economic liberalization must be complemented with internal compensation and social insurance for groups who suffer from globalization and who would otherwise increasingly oppose its further evolution, is not likely to be easily received by those who have struggled long against just such concepts.

Around the world, the incomes of the richest 20 percent grew three times faster than the incomes of the poorest 20 percent from 1960 to 1990. As a result, the share in global income of the poorest 20 percent of the world's population has fallen from 2.3 percent to 1.4 percent, according to the U.N. Development Program. The richest 20 percent of the earth now earn 85 percent of the money, compared with 70 percent three decades ago.

This growth in inequality appears to be positively correlated with the new model of economic growth in the developing world, driven by large increases in trade and private foreign investment. As developing countries have adopted free-market policies, privatized state industries and opened their borders, private firms and investors have poured $420 billion into their economies since 1988. But as international trade and investment leap over national boundaries, it has become easier, too, for the problems of inequality and poverty to cross borders.

5. Issues for Developing Countries

In some important ways, the telecommunications sector is not typical of traditional markets. Most of the demand for telecommunications products and transport is derived demand. Money is spent on them not so consumers can admire the ethereal beauty of fiber optic cable, or the pleasing geometry of a rack of digital switches. Telecommunications products and services are merely a means to an end – or, more accurately, an array of ends. These "ends" include not only improved personal and business communications, but enhancements for education, health care, government services, national development, entertainment, culture, etc. Consequently, in the area of policy, there is a greater likelihood that discussions of the physical means of information transport will be conflated with the ends of such transport. This is not just a philosophical observation – it has very real consequences, especially for developing countries. Some fear the network of telephones, computers and television will strip developing countries (and perhaps some developed countries) of their identity and sovereignty, and that they do not have the resources to participate fully in the projected benefits.[17]

In addition, less developed nations have additional hurdles to effective participation in the benefits of the Agreement. Services liberalization is not a short-term panacea, since the required changes take quite a long time to produce results despite the high transition costs which must be undertaken in the early stages of the process. And multilateral agreements produce relative advantages and disadvantages which vary depending on the relative power and influence of the parties, and their ability to take advantage of market opportunities. The telecommunications playing field is "level" only in a very peculiar sense – in the sense that "the rich and poor alike are forbidden to sleep under the bridges of Paris."

The bases for these arguments, which are typically described as protectionist by free-trade absolutists, include: the desire to protect companies in a service sector which is not yet able to compete effectively with foreign entrants; the view that the adjustment costs impose too high a social and economic cost; likely negative balance of payment effects since increased revenues from call volume are unlikely to offset lost revenues from lower prices; and a desire to protect a sector which is considered important for the preservation of cultural integrity and national security.

These factors raise a number of troubling questions for developing countries[18]:

- What will be the effects of lost revenues to incumbent dominant (or monopoly) national carriers? To the extent "excess" revenues were contributed to general government funds, what other infrastructure or social programs will be effected? What will be the effect on that carrier's ability to continue to build, maintain or upgrade its system? Will there be a negative net effect on the nation's balance of payments?

- What will be the effects on its ability to raise capital if it is privatized? While the Agreement will be a boon for some of the world's most aggressive phone companies, it could hit emerging markets and their phone companies hard. William Laurent, an analyst at Robert Fleming in London, estimates that six of the largest Latin American phone companies together could lose $1.2 billion in profits, almost a third of their earnings, from increased international phone competition. "I don't think the market has fully factored it in," says Andrew Harrington, a Salomon Brothers analyst. "The risk factor of the industry is going to go up very substantially."[19]

- What will be the effects on employment in countries where many are already chronically unemployed or underemployed? In the best case, there may be, over time, a net employment gain from competitive entrants. But will there be retraining or support for those displaced in the meantime? If they are represented by government unions, will they array their political influence against further opening markets? Will there be strikes and/or riots (France and India come to mind as examples in the not-too-distant past) causing governments to retrench?

- Will new foreign entrants, by offering higher salaries, drain the competent management and technical manpower from national incumbents? Or, given the expected world-wide explosive growth in this area, will the best immigrate to markets where they can find superior compensation?

- What will be the effect on preferred or "national hero" providers, who provide local employment and wield political influence? Will domestic companies be able to compete for contracts?

- What will be the reaction of nationalist parties and the military who see domestic carriers both as symbols of national honor and as facilities which must be controlled in the interest of national security?

- What will be the reaction of political parties who believe the government should serve a social welfare function (and such parties are not only to be found in developing countries)?

- What will be the reaction of those who control the media and consider themselves guardians of cultural (and sometimes religious) national integrity?
- Will the foregoing groups be driven to unite politically to sabotage or reverse the ends intended by the Agreement?
- Will "foreign" market entrants engage in "cream-skimming" profitable business and upscale customers, and in serving only desirable urban, and not rural, areas? Will this further reduce the ability of the incumbent, with a national service obligation, to compete? Will new entrants have any commitment to accessible, affordable "universal service" (however that may be defined)?
- Will "foreign" entrants, with more capital and more management and technical expertise be able to "game the system" and manipulate institutional arrangements within the WTO (such as dispute settlement procedures) rules in ways that disadvantage national incumbents? There is little acknowledgment that the ability of different countries to manipulate these institutional arrangements will vary considerably and that richer nations which are well resourced with technical expertise are much more likely to benefit from the contradictions of a system which is continually growing in complexity.
- Will the predicted increase in international traffic put an overwhelming strain on existing domestic facilities, for which there is insufficient capital and manpower to upgrade?
- Will the WTO Agreement result in a one-way street for large companies going into developing countries? As a result of the liberalization in telecommunication services, operators in the developing countries theoretically have access to a larger "foreign" markets. However, only a small sub-set of the developing countries' firms will be able to take advantage of these opportunities. Conversely, their home markets will be open to entrants from any WTO member country.

As barriers to cross-border telecoms services start crumbling as of January 1, 1998, there's little doubt that it will be the world's top carriers and suppliers, with experience in operating in liberalized, competitive environments, which will reap the immediate benefits. "United States companies are the most competitive telecommunications providers in the world; they are in the best position to compete and win under this agreement," boasted U.S. Trade Representative Charlene Barshefsky after the deal was secured.[20]

Asia-Pacific nations are watching these development closely. "The world telecoms revolution is certainly happening," says Byung-il Choi, director for International Telecommunications and Trade Policy at the Seoul-based Korean Information Society. "But, the question is how do all Asian countries take advantage of it?"[21]

Overall, the WTO Agreement has ample support among APEC countries. Critics, however, see APEC, following the lead of the WTO, as a "Trojan Horse" for the institutionalization of unequal relations under the guise of a level playing field. According to them, if this path is followed, hard won labor rights will erode; falling government revenues will generate a stronger push to dismantle social programs; and APEC will accelerate the "race to the bottom" - the harmonizing down of working and living standards to the lowest common denominator.

6. Policies to Compensate for Unintended Adverse Impacts

The authors believe there is considerable potential for mischief to the achievement of the desired ends of the WTO Agreement latent in the factors set forth above. For free-market purists, theory dictates that all such issues are irrelevant, and only the relentless forces of the market, in an environment of totally free trade, will maximize the potential benefits of the WTO Agreement. However, as noted above, this is not about trade in corn, or cement, or sneakers.

Telecommunications, politics, and the forces of development seem to go hand in hand, and a sensitivity to these issues seems to us to be good economics, good politics and good business.

The answer to the challenges presented by implementing the Agreement in developing countries does not lie in trying to roll back or constrain the forces of trade, investment capital and technology. In part, the answer lies with individual governments ensuring that they pursue sensible domestic policies which couple enhanced competitiveness with effective adjustment programs, and that they respect internationally recognized social standards. An example might be support for initiatives like Australia's "Casualties of Telecom" program, in which actual and potential telecom stakeholders self-identify issues.[22]

The answer lies as well with multilateral institutions such as the WTO which must seek to mesh telecommunications services investment and the social dimensions of economic development within its mandate. Such multilateral organizations can also assist with the collection and tracking of pertinent data. They should identify ways to measure the net inflow or outflow of resources to developing countries under the Agreement. They should ensure that developing countries have access to the resources necessary to fully understand the implications of whatever levels of commitment to liberalization they adopt. They should undertake a thorough factual analysis of the applicability of generalized conclusions about the Agreement to countries of small size. They should study the relevance of "social clauses" (NAFTA is an example) to telecommunications agreements. Their economists should look closely at theories of "infant industries" and "market failures" as they apply to developing countries.

The WTO, UNCTAD and ITU should offer technical cooperation programs to train government officials. They should assist in developing cooperation and information exchange among developing countries to make governments more aware of the consequences of their decisions. They should also establish mechanisms for close cooperation between trade specialists and telecommunications policy makers, and for sharing of expertise at the regional level

In the face of weakened nation states, one way that discipline may be imposed on global telecommunications enterprises is through enhanced powers for supra-national regulatory bodies. According to Secretary-General of the International Telecommunications Union, Dr. Pekka Tarjanne:

> "We already have the technology necessary for a global information society. But the global information economy - and society itself - will require a new system of rights and obligations, and a new system of regulatory principles.
>
> Above all, regulators must strive to guarantee that everyone has access to basic telecommunication services. This, along with other human rights, is most certainly the issue of this decade as well as the next one. The authorities responsible for creating a common international regulatory framework will have to work together in close co-operation. The relationship between national and international regulation has changed forever. Today's issues are global issues, and they require global solutions."[23]

Some business leaders see engagement with these issues as simply a matter of corporate enlightened self-interest. A good example of this kind of strategic vision (of sensitivity to contextual issues) was given by IBM Chairman and CEO Louis Gerstner:

> A few decades ago, there was another "defining" technology. You may remember it: nuclear power. It, too, was going to change the world. It was going to make energy as cheap as water . . . bring air conditioning to deserts, heat to frozen tundras.
>
> Reactors would power cars and ships, airplanes and spacecraft. Inexhaustible energy.

> But what happened? The nuclear power industry is a dormant industry today.
>
> Those grand visions were never realized. Why? Was it because of bad science, disappointing technology? Not really.
>
> While that industry was focused on megawatts and reactor cores, communities and governments were worried about the implications of that technology. They stopped the industry dead in its tracks.
>
> Today, our industry has grand visions. I've shared some of that with you this morning. And they are grand. And very ambitious. We're talking about no less than changing the world in very fundamental ways.
>
> Yes, too often, what are we focused on? What will you hear and see here at Comdex? Megahertz, gigabits and multitasking. There's a disconnect between our priorities and those of a lot of people and governments.
>
> So, I'd like to leave you with the thought that the time has come to step up to these challenges. Even as we continue to innovate and create, we must now also think about the broader implications of the future we are creating.[24]

Another example comes from a leading Canadian businessman, who said:

> While some of those voicing concerns are little more than protectionists and reactionaries in disguise, the negative effects of economic liberalization must be taken seriously . . . .
>
> Whether at the World Trade Organization, or at the OECD, or at the United Nations, a powerful case can be made that a universal acceptance of the rule of law, the outlawing of corrupt practices, respect for workers' rights, high safety and health standards, sensitivity to the environment, support for education and the protection and nurturing of children are not only justifiable within the context of morality and justice. The simple truth is that these are good for business and in most cases lead to enhanced productivity, greater loyalty in the work force, broader community acceptance and ultimately to stronger profitability.[25]

He advocates the adoption of voluntary corporate codes of conduct, which he believes have the advantage that they provide policy direction from the boardroom to the frontlines of corporate operations in any part of the world.

At least one company sees the developing world as a challenge. Satellite company Teledesic Corp. says it will give away some of its telecommunications capacity to help developing countries. Russell Daggatt, the company's president, told Reuters the offer meant several regions and countries would have free access to some of the fastest communications available for health or educational purposes.[26] Perhaps enlightened leadership from the corporate sector will help address some of these issues.

Yet multinationals answer increasingly to forces beyond their own control: stock markets driven by institutional investors ready to bail out at the drop of a fraction. And who are the institutional investors? Pension funds, trade unions, mutual funds, all owned by the "little people," many of whom are themselves ill at ease about the direct and indirect consequences of globalization. So, ultimately, a part of the solution must be public education at every level, along with public debate which recognizes both the complexity and the sensitivity of the issues at hand and is respectful of the fact that, as yet, no one has all the answers.

---

[1] Prof. Richard D. Taylor, J.D., E.D., James R. and Barbara R. Palmer Chair in Telecommunications Studies, College of Communications, The Pennsylvania State University.

[2] Meheroo F. Jussawalla, Ph.D., Emerita Senior Fellow/Economist, The East-West Center

[3] Ruggiero, R., "The High Stakes of World Trade", The Wall Street Journal Interactive Edition, April 28, 1997, Edit Page Features.

[4] One Canadian business leader described these values as: respect for the rule of law, an abhorrence of corrupt practices, respect for workers' rights, a distaste for discriminating practices, acceptance of the importance of safety and health standards, sensitivity to the environment, and an unwillingness to exploit children.

[5] Ruggiero, R., "The Road Ahead: International Trade Policy in the Era of the WTO," The Fourth Annual Sylvia Ostry Lecture, Ottawa, May 28,1996 (issued by the Information and Media Relations Division of the World Trade Organization).

[6] Erlanger, S., "Malaysia's Conspiracy Theory Draws Criticism From Albright," The New York Times, July 29, 1997, p. A8.

[7] Cited in Marcelle, G., "WTO Negotiations on Basic Telecommunications: Implications for Developing Countries – Case of Latin American and the Caribbean," presented at Telecom Americans, June 1996.

[8] Jussawalla, M. and Tehranian, J., "GATT and Economic Development: Trade in Information and Telecommunication Services in Theory and Practice," unpublished paper, East-West Center, 1996, pp. 3 et seq.

[9] Jones, I., "What is the World Trade Organization and Why All the Ruckus About It," World Trade, December 1996/January 1997, p. 27.

[10] Marcelle, G., "WTO Agreement on Basic Services: Background of Trade Negotiations Under the WTO," http://www.analysys.co.uk/products/regulat/wto/ (July 1997).

[11] "Basic Telecom Agreement Joined by 68 Countries," Memorandum, Transnational Data Reporting Service, Inc., February 18, 1997.

[12] Wilke, J., and Naik, G., "International Phone Calls Costs are Cut," The Wall Street Journal, August 8, 1997, p. A3.

[13] Schiesel, S., "Telephone Pact to Alter Rates and Services," The New York Times, February 17, 1997, p. 46.

[14] "Not Quite Magic," The Economist, February 22, 1997, p. 68.

[15] Schiesel, S., "Telephone Pact to Alter Rates and Services," The New York Times, February 17, 1997, p. 46.

[16] Rodrik, D., Has Globalization Gone to Far?, Washington, D.C.: Institute for International Economics, 1997.

[17] McEvoy, J., "Third World Wonders About Information Highway," Reuters, February 28, 1995.

[18] Special recognition must be given to the work of Dr. Gillian Marcelle in developing these concepts.

[19] Lavin, D., Naik, G. and Bahree, B., "Pact May Put phone Firms on the Line: Global Competition Could Thin Ranks, Please Customers," The Wall Street Journal, February 14, 1997, P. A10.

[20] Andrews, E., "68 Nations Agree to Widen Markets in Communications," The New York Times, February 16, 1997, p. 1.

[21] Islam, S., "Conference Call," Far Eastern Economic Review, June 12, 1997, p. 45.

[22] Lamberton, D., "Ethical Issues for Telecommunications: An Australian Perspective," Pacific Telecommunications Review, June 1997, p. 8.

[23] Tarjanne, P., "The Changing Relationship Between National and International Regulations", Center for Tele-Information (CTI) Course for Telecom Regulators, January 28, 1996.

[24] Gerstner, L., Keynote Address (Untitled), Comdex '95, Las Vegas, Nevada, November 13, 1995.

[25] D'Aquino, T., "Globalization, Social Progress, Democratic Development and Human Rights: the Responsibility of a Multinational Corporation," delivered to the Academy of International Business, Banff, Canada, September 27, 1996.

[26] McEvoy, Feb. 28, 1995.

Direct Broadcast Satellite Radio System Implementation

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ABSTRACT

The first domestic satellite radio system is currently under implementation to provide mobile service throughout the contiguous 48 United States starting in late 1999. This will culminate almost a decade of deliberation and effort.

BACKGROUND

The technical possibility of providing radio service from satellites directly to listeners in homes and cars was recognized in the late 1980s. This was followed by numerous technical and economic studies. The studies were done by governmental and private organizations and contemplated the provision of satellite radio service on a domestic, regional and global basis. Most of these studies were submitted to the then called CCIR Study Group 10/11S [1]. In May 1990, a private United States organization submitted an application to the Federal Communications Commission (FCC) for permission to implement a direct-to-mobile user satellite radio service. The implementation of this service for operation in late 1999 is described subsequently, noting that several design changes were required over this long gestation period. Also, over this period, several nomenclatures for the service have been used such as DAB (Digital Audio Broadcasting), DBR (Direct Broadcast Radio), S-DARS (Satellite-Digital Audio Radio Service), DBSR (Direct Broadcast "Satellite Radio"), etc.

TECHNICAL ASPECTS

Certain key technical aspects are of major importance for implementation of satellite radio service [2] to mobile users.

Radio Frequency. One reason for the length of the gestation period was the need to allocate radio frequencies for provision of this service. The studies mentioned in the last section showed that the frequency range from 1-3 GHz was best suited technically for providing the critical satellite downlink (i.e., satellite to mobile user transmission path). However, the particular bandwidth selected for such satellite radio service in a particular country or region must not contain transmitters of other services which could interfere. The frequency range 1-3 GHz is free from attenuation/distortion effects both from the ionosphere and from atmospheric moisture and, therefore, has been highly used by other services (e.g., radars, radio relay, navigation, mobile aeronautical telemetry, space exploration, etc.). An effort was made in the early 1990s to allocate 1452-1492 MHz for the downlink on a global basis. This was not possible due to the previously noted interfering services and, consequently, at the World Administrative Radio Conference (WARC) in 1992, countries also allocated 2310-2360 MHz and 2535-2655 MHz.

Satellite Radiated Power. As described more fully elsewhere [2], the user antennas must have low directivity for use in mobile (i.e., automobile) applications where only a few decibels of gain are possible with low cost designs. This, coupled with the need for transmission margins to overcome multipath fading and the desire to provide the user multiple radio channels for choice of music and voice programming, results in the requirement for very high satellite radiated power and correspondingly high power flux densities (e.g., -134 dBW/m^2/4kHz). Interference coordination with countries adjacent to the service area is generally necessary due to the high flux densities. Lastly, the high satellite radiated power requires large and relatively expensive satellites and their associated launch vehicles.

Audio Compression. The use of video compression has made direct broadcast satellite television economically feasible. Similarly, the use of audio compression is fundamental in the economics of satellite radio. Compression of Compact Disk (CD) stereo music by a factor of 12 has been successfully demonstrated and further work is on-going. Compression of voice is similar, with MPEG 2.5 providing a wide range of compressed digital rates and associated speech qualities.

IMPLEMENTATION

The system to be described was licensed by the FCC in October of 1997 to provide a digital satellite radio service throughout the contiguous 48 United States using the satellite downlink radio frequency band 2320-2332.5 MHz. The service provides 30 CD quality music channels and 20 voice channels to users, primarily in their vehicles, on a subscription basis.

System. The system employs two geosynchronous satellites located at 80° and 110° West Longitude which broadcast the same transmissions so as to achieve satellite spatial diversity. These locations provide high elevation angles to users throughout the service area. Combined with the further use of time diversity and spread spectrum transmission, the effects of service outages from multipath fading and blockage are minimized. In core urban areas and in long tunnels, where the satellite signals are obstructed for long periods, terrestrial repeaters of the satellite signal are used to provide continuous high service quality.

Satellites. The satellites are being manufactured by Space Systems/Loral. Figure 1 is a drawing of the satellite, and Figure 2 is the block diagram of the communications payload. The effective isotropic radiated power from each satellite is over a megawatt at the edge of the service coverage area shown in Figure 3. Three satellites are being constructed with two to be launched and a third serving as an on-the-ground spare. The satellite design lifetime is 15 years.

Launch Vehicles. The satellites will be launched by Arianespace using the Ariane 5 rocket launched from Korou, French Guyana. The first launch is scheduled for August 1999 and the second for October 1999.

Programming/Up-Link/TT&C. A national programming studio is being constructed in the New York City area to provide the programming for the 50 previously mentioned audio channels. A typical music format for the 30 channels is shown in Figure 4. The studio up-links the programming to both satellites using the 7025-7075 MHz frequency band. The studio also performs on-orbit TT&C using the 7025-7075 MHz band for transmitting commands and receives two beacons radiated from the satellite near 2320 MHz for telemetry. TT&C during transfer orbit and non-standard situations is performed at frequencies in the 6/4 GHz frequency band.

Vehicle Radios. The primary service users are expected to be mobile (i.e., automobiles, trucks, recreational vehicles, etc.). Although eventually radios suitable for receiving satellite service will be delivered incorporated in the electronics of new cars, users are expected initially to obtain receivers capable of receiving satellite radio service either by purchasing an adapter, called a radio card, or by purchasing an aftermarket radio. A simplified block diagram of the aftermarket radio is shown in Figure 5. It depicts a combined AM/FM/Satellite Radio configuration with the darker boxes showing what is added for obtaining satellite radio capability and the light boxes showing the normal AM/FM capability. The two medium color boxes depict an additional possible future capability where a digital signal is broadcast terrestrially by a radio station combined with its FM analog broadcast [3]. This is called IBOC (In-Band On-Channel). Figure 6 shows a demonstrational working embodiment of the aftermarket radio. The satellite radio capability is achieved by a three chip "chipset". The same chipset is used in the radio card shown in Figure 7 which is inserted into the existing radio receiver tape cassette player. The only addition is a wireless link from the antenna shown in Figure 8, which is adhesively attached like a cellular rear window mount, to the cassette insertion unit shown in Figure 7. It is also noted that there is an encrypted service channel in addition to the program channels previously described. Each receiver in the system is

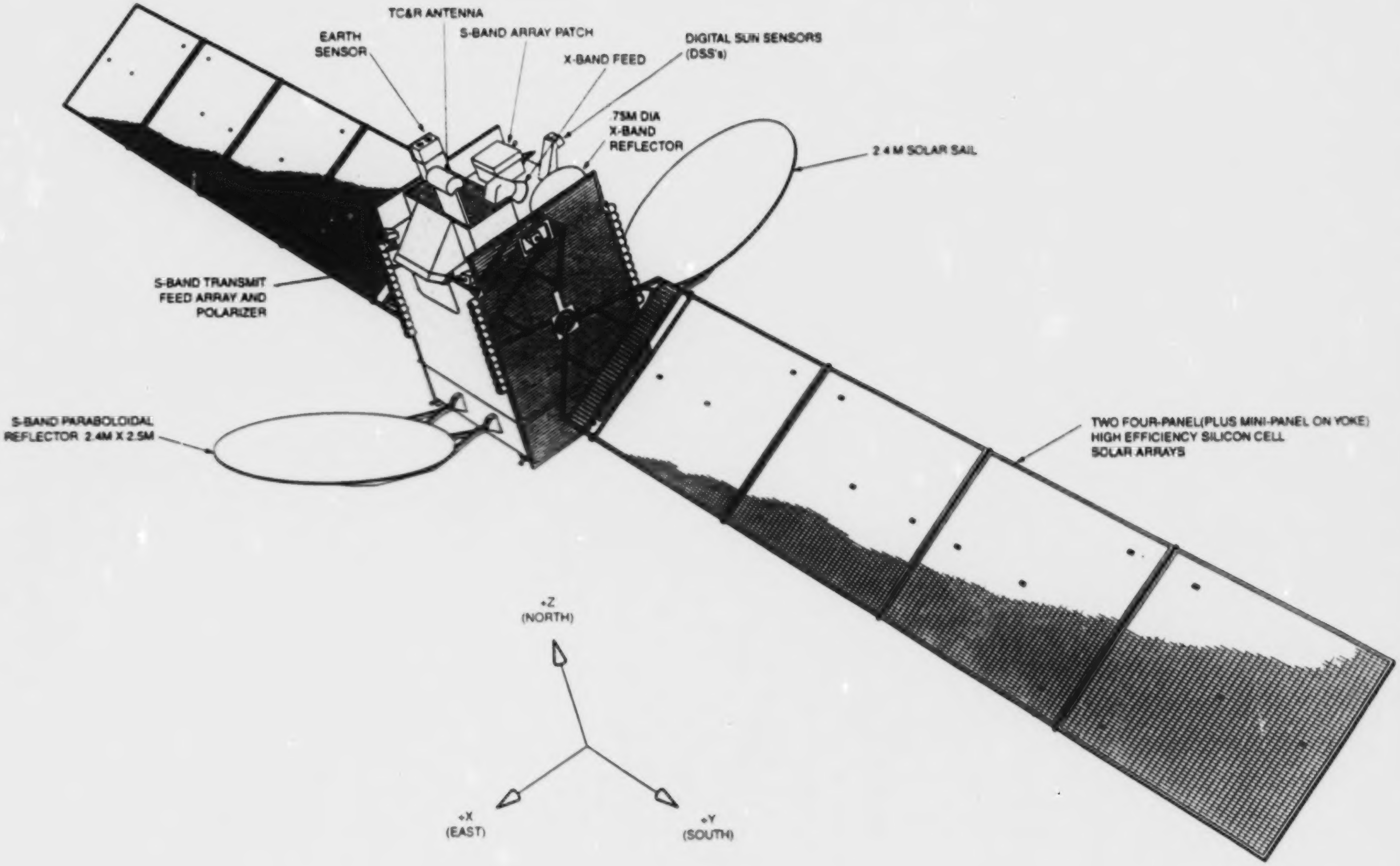
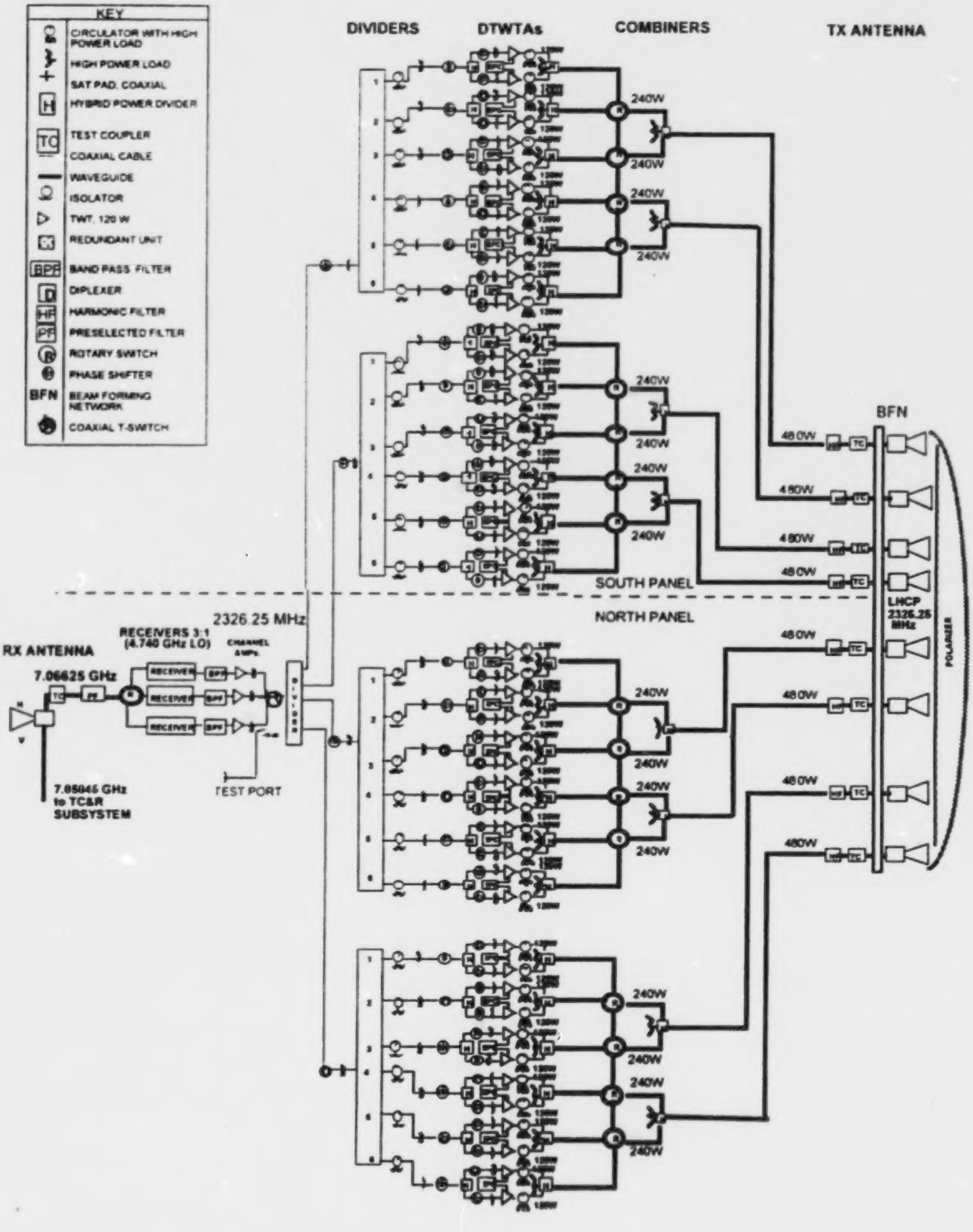
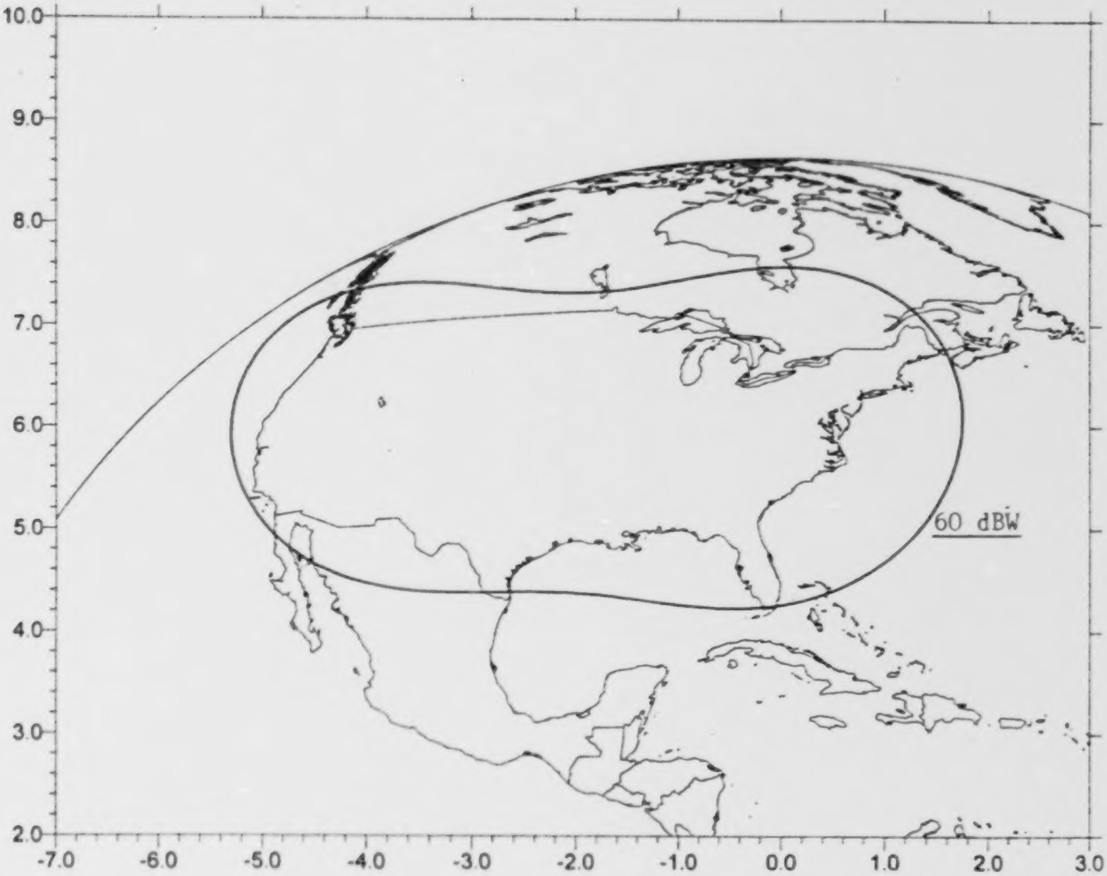

TC&R ANTENNA
EARTH SENSOR
S-BAND ARRAY PATCH
DIGITAL SUN SENSORS (DSS's)
X-BAND FEED
.75M DIA X-BAND REFLECTOR
2.4 M SOLAR SAIL
S-BAND TRANSMIT FEED ARRAY AND POLARIZER
S-BAND PARABOLOIDAL REFLECTOR 2.4M X 2.5M
TWO FOUR-PANEL(PLUS MINI-PANEL ON YOKE) HIGH EFFICIENCY SILICON CELL SOLAR ARRAYS
+Z (NORTH)
+X (EAST)
+Y (SOUTH)

FIGURE 1


KEY
CIRCULATOR WITH HIGH POWER LOAD
HIGH POWER LOAD
SAT PAD, COAXIAL
HYBRID POWER DIVIDER
TEST COUPLER
COAXIAL CABLE
WAVEGUIDE
ISOLATOR
TWT, 120 W
REDUNDANT UNIT
BAND PASS FILTER
DIPLEXER
HARMONIC FILTER
PRESELECTED FILTER
ROTARY SWITCH
PHASE SHIFTER
BFN
BEAM FORMING NETWORK
COAXIAL T-SWITCH
DIVIDERS
DTWTAs
COMBINERS
TX ANTENNA
240W
480W
BFN
SOUTH PANEL
NORTH PANEL
LHCP 2326.25 MHz
POLARIZER
2326.25 MHz
RX ANTENNA
7.06625 GHz
RECEIVERS 3:1 (4.740 GHz LO)
CHANNEL AMPS
RECEIVER
BPF
TC
PF
TEST PORT
7.05045 GHz to TC&R SUBSYSTEM
120W

Payload Block Diagram

FIGURE 2


10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
-7.0
-6.0
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
60 dBW

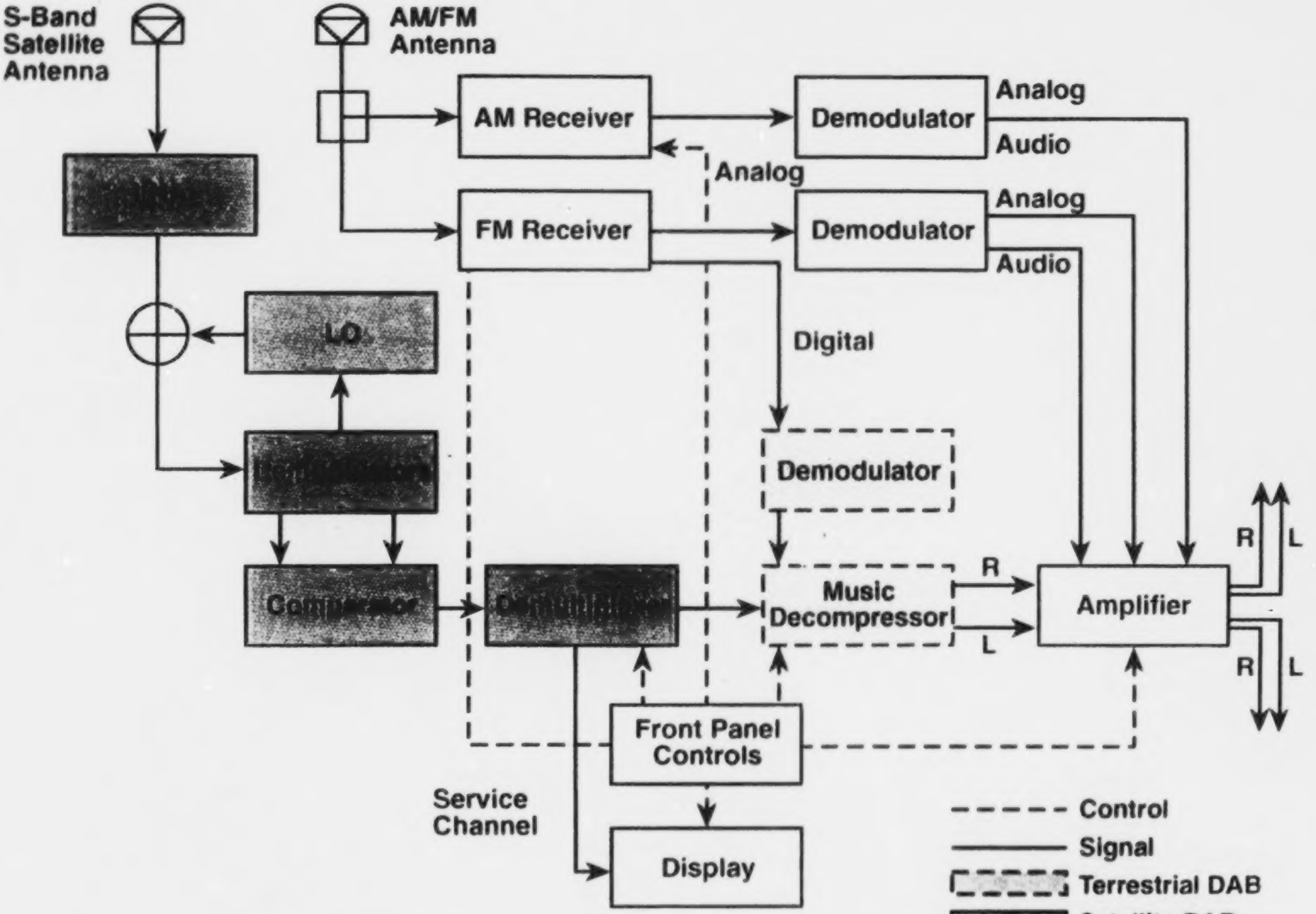
80° West, 0° North, S-Band Transmit Antenna

FIGURE 3

Channel Listing

1. ***Symphonic***
   Music from the masters. Bach, Mozart, Handel. The world's greatest classical composers broadcast in brilliant CD fidelity.
2. ***Chamber Music***
   Elegant music performed by small ensembles of solo instruments such as the cello, violin and woodwind.
3. ***Opera***
   Experience the drama and spectacle of the greats. Verdi, Puccini, and Wagner.
4. ***Today's Country***
   The fresh, honest sounds of today's country stars including Vince Gill, Alan Jackson, Leann Rimes and Garth Brooks.
5. ***Traditional Country***
   All of your favorite country legends are here. Stars like Merle Haggard, Loretta Lynn, Hank Williams, Jr. and George Jones.
6. ***Contemporary Jazz***
   The syncopated rhythms of today's jazz music. The cool sounds of Kenny G, Fourplay and David Sanborn.
7. ***Classic Jazz***
   The mood is magic when the music is improvised. Listen as musicians like Duke Ellington, Miles Davis and John Coltrane experiment and expand the sounds of jazz.
8. ***Blues***
   The foundation of rock. The window to the soul. B.B. King, Muddy Waters and Robert Cray.
9. ***Big Band/Swing***
   A time of great drama. Relive the memories with the sounds of Tommy Dorsey, Glenn Miller and Artie Shaw.
10. ***Top of the Charts***
    Today's hot hits from recording artists such as Sheryl Crow, Mariah Carey and Boyz II Men.
11. ***Classic Rock***
    Timeless tracks from the 60's and 70's—an entire generation of great rock music. The Who, Rolling Stones and Eric Clapton.
12. ***50's Oldies***
    Sock hops and going steady. Tune in and experience it all over and over again with Chuck Berry, Little Richard and Elvis Presley.
13. ***60's Oldies***
    Put the top down and cruise to the sounds of the sixties. The solid gold sounds of Motown, Stax, the British Invasion and more.
14. ***Folk Rock***
    Thoughtful, inspired melodies from performers like Joni Mitchell, James Taylor and Joan Baez.
15. ***Latin Ballads***
    The enduring romantic sounds of Latino vocalists. Julio Iglesias, Nino Bravo and Roberto Carlos.
16. ***Latin Rhythms***
    Move to the music of Ruben Blades, Albita, Juan Luis Guerra, and the legendary Tito Puente.
17. ***Reggae***
    Pulsating rhythm from the musically prolific island of Jamaica. Skanking all the way back to the Skatelites up through Bob Marley and Shabba Ranks.
18. ***Hip-Hop & Rap***
    The forefront of contemporary music. The Fugees, Heavy D and Dr. Dre.
19. ***Dance***
    Techno, club and pop remixes from around the world make this one of the hottest spots on the dial.
20. ***Urban Contemporary***
    The soulful sounds of Toni Braxton, Luther Vandross, Keith Sweat and Mary J. Blige.
21. ***Soft Rock***
    Mainstream pop hits from artists like Celine Dion, Phil Collins, Gloria Estefan and George Michael.
22. ***Singers and Songs***
    The greats sing the standards, with legends like Frank Sinatra, Nat King Cole, Tony Bennett and Barbra Streisand.
23. ***Beautiful Music***
    Memorable melodies of contemporary music orchestrated with a full, lush and easy sound.
24. ***Album Rock***
    Mainstream rock from veteran bands and new artists, including Aerosmith, Collective Soul, Dave Matthews Band, John Mellencamp.
25. ***Alternative Rock***
    Modern rock from such diverse bands as Beck, Live, Stone Temple Pilots, and Smashing Pumpkins.
26. ***New Age***
    Sounds that soothe and transport. Relax with Jim Brickman, Kitaro and Yanni.
27. ***Broadway's Best***
    The Great White way shines with all your favorites from the past and today's hot new shows. Rodgers and Hammerstein, Marvin Hamlisch, and Andrew Lloyd Webber.
28. ***Gospel***
    Soulful gospel sounds of joy. Mahalia Jackson, Al Green and the Winans.
29. ***Children's Entertainment***
    Entertaining songs and storytelling for younger listeners. Fred Penner, Raffi and Tom Chapin.
30. ***World Beat***
    The Beat goes on...all over the world. Follow the sun with the music of Lucky Dube, Youssou N'Dour and Outback.

FIGURE 4


S-Band
Satellite
Antenna
AM/FM
Antenna
AM Receiver
FM Receiver
Demodulator
Analog
Audio
Demodulator
Analog
Audio
Analog
Digital
LO
Demodulator
Comparator
Demultiplexer
Music
Decompressor
R
L
Amplifier
R
L
R
L
Front Panel
Controls
Service
Channel
Display
Control
Signal
Terrestrial DAB
Satellite DAR

BEST COPY AVAILABLE

FIGURE 5

individually addressable, and one purpose of the service channel is the authorization/termination of each subscriber's access.

SUMMARY

A new radio service for United States mobile subscribers is being implemented for availability in late 1999. The service is the first major advancement in radio since the implementation of stereo FM. It will provide digital transmission of multichannel music and voice throughout the 48 contiguous United States.

REFERENCES

[1] ITU-R, BO. 955-2, "Satellite sound broadcasting to vehicular, portable and fixed receivers in the range 500-3000 MHz", Section 11 (Sharing), Geneva 1994.

[2] R. D. Briskman, "Satellite DAB", *International Journal of Satellite Communications*, Vol. 13, July-August 1995, pp. 259-266.

[3] D. H. Layer and D. Wilson, "IBOC DAB: Its Potential for Broadcasters", National Association of Broadcaster's *1996 Broadcast Engineering Conference Proceedings*, April 1996, pp. 14-19.

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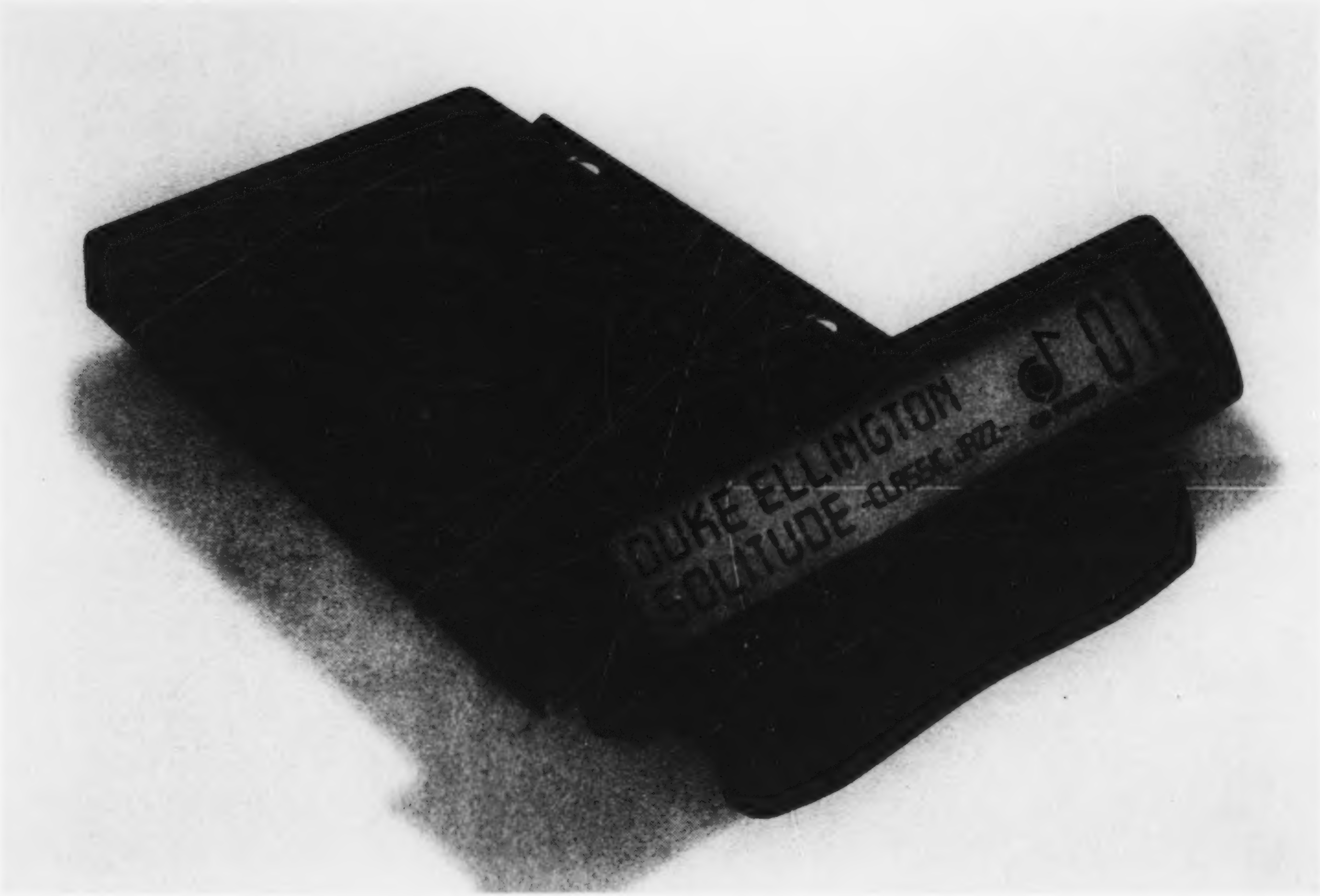
DUKE ELLINGTON
SOLITUDE
-CLASSIC JAZZ-
01

545

544

512

546

547

HF Digital Broadcasting:
Progress Using a System Designed by the Voice of America and the Jet Propulsion Laboratory

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Washington, DC

1. ABSTRACT

Digital satellite audio broadcasting technology developed by a joint Voice of America (VOA), Jet Propulsion Laboratory (JPL) project has been recently applied to a system for digital audio broadcasting in the short wave bands. A receiver has been designed, built, and tested in the field. This paper presents an overview of the VOA/JPL HF Digital System development to date.

2. INTRODUCTION

Some of the propagation impairment mitigation techniques that were developed for digital satellite audio broadcasting by VOA/JPL have been applied to a system design for digital short wave broadcasting. A receiver incorporating these techniques has been built and tested in the field.

A total of three field trials have been accomplished with the VOA/JPL system to date. The first was accomplished in October 1996, with the main purpose being propagation measurements over a variety of transmission paths. The transmit site was the VOA Delano, CA, Poppele Transmitting Station, while reception sites were at Austin Texas, Washington DC, and Tenerife, Spain.

The second and third transmission tests were accomplished in May 1997 and September 1997. Signal reception took place at the VOA headquarters building in Washington DC. These tests included both propagation measurements and performance (bit error rate) measurements with various modulation formats. Two frequencies were used during both tests. The VOACAP program was used to select the best frequency that would provide a single hop path to Washington DC, and another frequency that would result in a multiple hop path.

A 50 kW linear transmitter, backed off to approximately 12 kW, was used during the May 1997 test. Propagation and performance measurements were made with a range of test signals.

A major objective of the September 1997 test was to interface a digitally modulated signal with a high power, non-linear, DSB AM transmitter and to investigate the effects on the resultant signal spectrum of various parameters of this interface. The modulator used with the linear transmitter was modified and interfaced with such a transmitter. Tests were conducted at power levels of 220 kW and 50 kW.

3. HIGH POWER TRANSMITTER INTERFACE

The transmitter used in the September 1997 test was DL-3, a 250 kW DSB AM transmitter equipped with a solid state modulator.

Since a digitally modulated signal, which uses pulse shaping to control the spectrum shape, has both phase and amplitude variations, the modulator was modified to separate these two components and interface with the transmitter as shown in Figure 1. One component becomes a constant amplitude carrier with phase modulation. This is put into the transmitter exciter input. The other is the amplitude, which is put into the AM modulation input.

The factors that affect the resultant spectrum shape are as follows:

- The excess bandwidth factor of the pulse shaping. The lower the value, the steeper the spectrum falls off. However the lower this value is, the larger the amplitude variation in the signal.
- The frequency response of the transmitter modulation input. A perfect frequency response would restore the signal spectrum

to its baseband shape, but the AM modulation input of DL-3 is AC coupled and has a finite high frequency response.

- The timing between the two signal components. The AM modulation input produced a time delay which must be compensated for. The JPL modulator allows delay adjustment both in software, at 1/48000 sec. intervals, and in finer increments in hardware.

The result of a typical spectrum measurement of the transmitter output is shown in Figure 2. The modulation rate was 8000 symbols per second. The modulation in this case is 8PSK with root raised cosine pulse shaping and an excess bandwidth factor of 50 %. Using DL-3, sidelobes on the order of -30 dB were achieved. At this level, the sidelobes were somewhat broader than could have been theoretically achieved with a perfect AM modulator. A lower excess bandwidth factor was tried, but the higher amplitude components in the signal made it more difficult for the DL-3 AM modulator and did not result in further sidelobe reduction. The transmitter was able to handle both PSK and QAM modulation at a close to full output power level and the resultant spectrum was very similar for all modulation formats.

4. RECEIVER BASELINE

A block diagram of the receiver is shown in Figure 3. The receiver operates at a symbol rate of 8 ksps. The processing part of the receiver is implemented in software on a PC platform. Currently the front end is a modified short wave receiver for tuning to the desired signal. It provides a 13 kHz IF which is recorded on a digital audio tape (DAT) recorder for non-real time processing.

Both the receiver and modulator are flexible in modulation type (MPSK/MQAM), interleaving depth, coding, and several equalizer parameters. The audio compression scheme is the AT&T G728 (LD-CELP) at 16 kbps.

The signal structure consists of frame synchronization and data blocks. Frame sync is a 63 bit PN sequence with an extra bit added at the end to make it an integral number of bytes (8). The frame sync sequence is always modulated using BPSK.

A data block can be an arbitrary number of bytes long, but should contain an integral number of audio frames. When coding is used, the data block length is set to have an integral number of Reed-Solomon and encoded audio blocks. The data block length used in the field trials was thus 255*M*8*40 data bits long. M is the number of bits per symbol in MPSK (3 for 8PSK) and 40 is the audio frame length in bytes.

Interleaving is done at the symbol level. When interleaving was used in the testing, the frame length was equivalent to the data block length (320 by 255 symbols). This results in a rather long interleaving delay (approx. 10 seconds) and would probably be made lower in a practical system.

A symbol from a known sequence of training symbols is inserted every N symbols. N was selected to be 4 (training symbol ratio 1 in 5) for the field trials.

4. PROPAGATION AND PERFORMANCE MEASUREMENTS

The signal test sequences for all tests were similar and included the following types of signals:

- Unmodulated Carrier - used to identify interferers in the signal bandwidth
- BPSK with a pseudonoise (PN) code - used to measure multipath (delay spread)
- MPSK up to 32PSK and 16 and 64 QAM with random data - used to measure bit error rate
- 8/16PSK with compressed audio - used for digital audio performance evaluation
- Analog DSB AM - used for evaluation of AM reception

In October 1996 the test frequencies used were 15.2 MHz and 5.9 MHz.

In May 1997 the frequencies used were 17.895 MHz and 13.73 MHz, at a transmit power of 12 kW from a linear transmitter.

In September 1997 the frequencies were 15.24 MHz and 12.03 MHz with power levels of 220 kW and 50 kW, using a non-linear transmitter.

4.1 PROPAGATION RESULTS

In general, all propagation paths had some multipath, with delay spreads in the range of 1 to 3 milliseconds. The largest (3 millisecond) delay spread was at 5.9 MHz, while the delay spread at the higher frequencies was closer to 1 millisecond.

The degree of multipath also varied widely. The highest and most interesting multipath structure, with three approximately equal power components, occurred during the May 1997 tests at 17.895 MHz. This is shown in Figure 4. There were also significant amounts of interference from other broadcasts during some tests.

4.2 PERFORMANCE RESULTS

Signals with modulation levels up to 8PSK have been demodulated with some success from both the May and September tests. Depending on the particular test conditions, bit error rates were obtained from near zero to greater than 5E-3. This is the point where an audio decoder would start producing noticeable distortion in the recovered audio.

The performance results are best illustrated by the results of demodulating some of the 8PSK, compressed audio test sequences (Sequence 17 from the September tests and Sequence 33 from the May tests). The compressed audio was encoded with a Reed Solomon (255, 223) code and time interleaved with an interleaver of approximately 10 seconds.

The Reed Solomon decoder can correct up to 16 bytes with any number of errors out of the 255 byte block. Thus with 16 or fewer corrupted bytes, the audio will be restored without error. If the number of bytes in error exceeds 16, the RS decoder does not correct any errors.

The implementation of the RS decoder in the receiver provides an indicator showing how many bytes per block were corrected. If the number of bytes in error exceed 16, no corrections are made and the decoder gives an indication of -1. A plot of this parameter is thus a good indicator of receiver performance. The following figures illustrate this for the September 1997 tests:

Figure 5 shows the number of byte errors corrected over the 4 minute sequence 17, at 220 kW and 15.24 MHz. Note that the audio will have no errors except for two very short instances in the middle of the transmission.

The results of the same format test sequence (Seq. 33, 8PSK, RS coded, compressed audio) from the May 1997 tests are shown in Figure 6. The propagation in this case approximated a three component Rayleigh condition, as shown in Figure 4. In addition, there was a signal fade during the first half of the sequence, which is the reason for the high error rate during the first two minutes. The signal fade is apparent from a recording of the received signal spectrum. Out of band noise is seen during the first half, which indicates that the signal was weaker and had been brought up, together with the noise, by the receiver AGC.

Since the transmitted test sequence is known, it is possible to determine the actual byte errors that occurred during the reception of this sequence. This result is plotted in Figure 7 and shows the coding overhead that would have been required to correct all errors during each portion of the segment.

Additional processing of this data was used to indicate the byte errors that would have occurred without time interleaving. This is shown in Figure 8. It can be seen that, in this case, if no interleaving had been used, additional segments could have been recovered error free during the first half of the sequence.

5. SUMMARY AND CONCLUSIONS

A system for digital audio transmission in the short wave bands was developed and tested over the air. Successful transmission of compressed audio with up to 8PSK modulation was accomplished during several tests. Link conditions during most of the tests were severe, as evaluated by listening to the DSB AM segments. Causes included low SNR, multipath, and interference from other transmissions.

Transmission at 8PSK in a 10 kHz channel allows a data rate of approximately 16 kbps, which is near AM quality. Further testing is needed under more benign conditions to determine if higher modulation levels and therefore higher data rates are practical. There is also further work needed in determining optimum coding overhead and the amount of time interleaving that is most effective under a greater variety of propagation conditions.

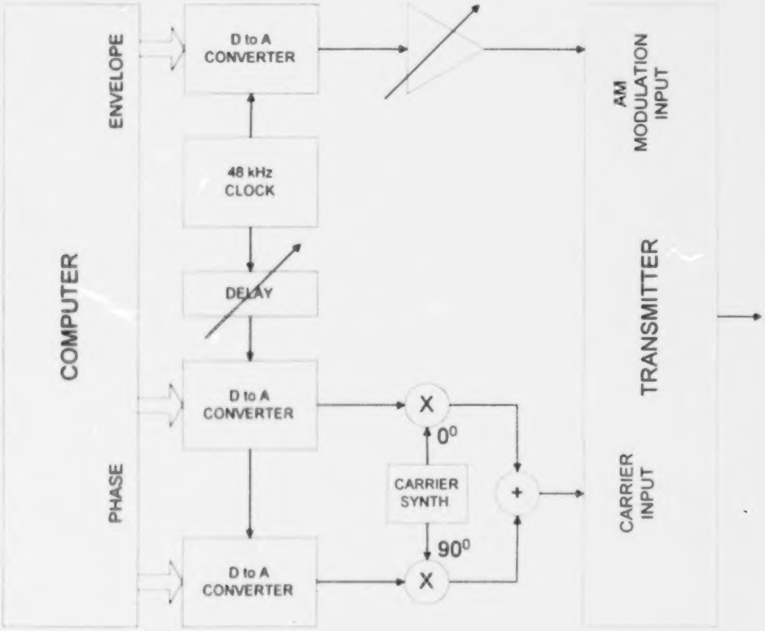

COMPUTER
ENVELOPE
PHASE
D to A CONVERTER
48 kHz CLOCK
DELAY
D to A CONVERTER
D to A CONVERTER
X
0⁰
CARRIER SYNTH
90⁰
X
+
AM MODULATION INPUT
TRANSMITTER
CARRIER INPUT

Figure 1. High Power Transmitter Interface

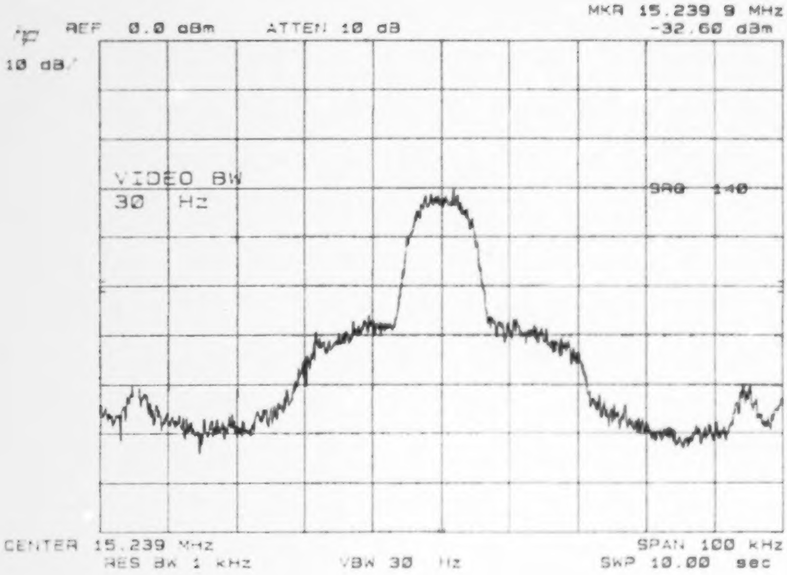


Figure 2. Transmitter Spectrum with 8PSK, RRC Modulation

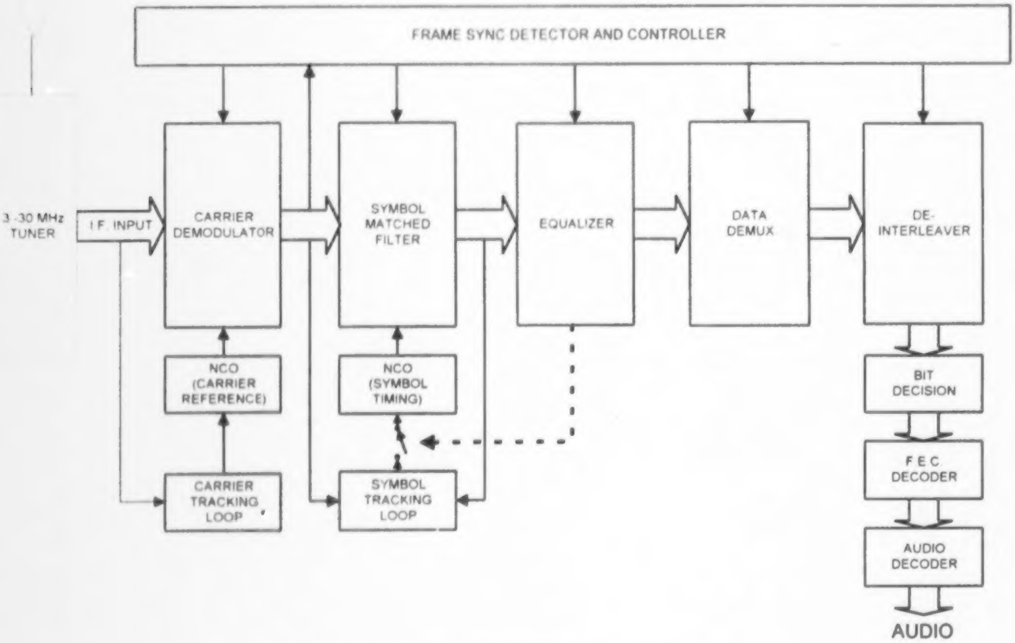

FRAME SYNC DETECTOR AND CONTROLLER
3-30 MHz TUNER
I.F. INPUT
CARRIER DEMODULATOR
SYMBOL MATCHED FILTER
EQUALIZER
DATA DEMUX
DE-INTERLEAVER
NCO (CARRIER REFERENCE)
NCO (SYMBOL TIMING)
CARRIER TRACKING LOOP
SYMBOL TRACKING LOOP
BIT DECISION
FEC DECODER
AUDIO DECODER
AUDIO

Figure 3. HF Digital Receiver Block Diagram

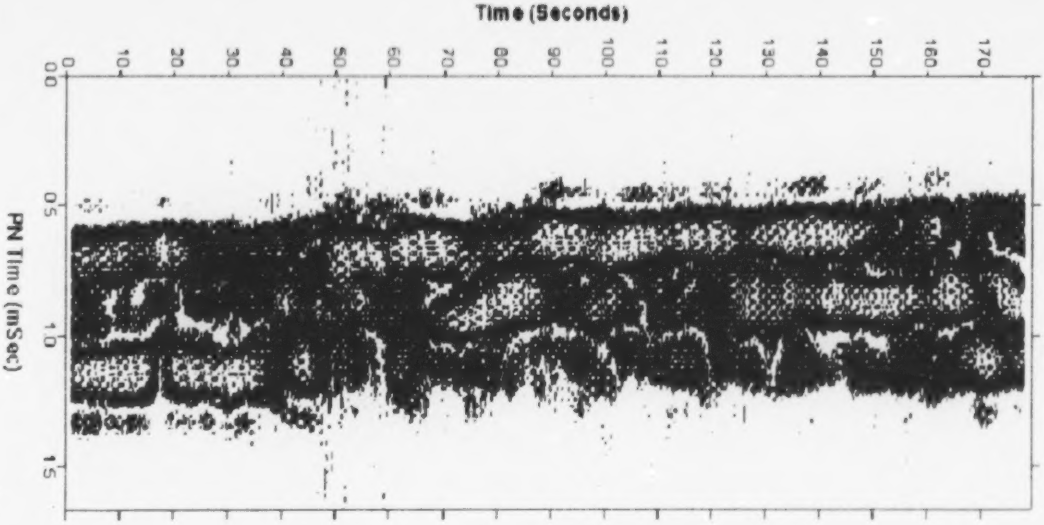


Figure 4. Multipath (Delay Spread) Measurement at 17.895 MHz, May 1997

R-S Decoder Performance (September1997, Sequence 17, 8PSK)

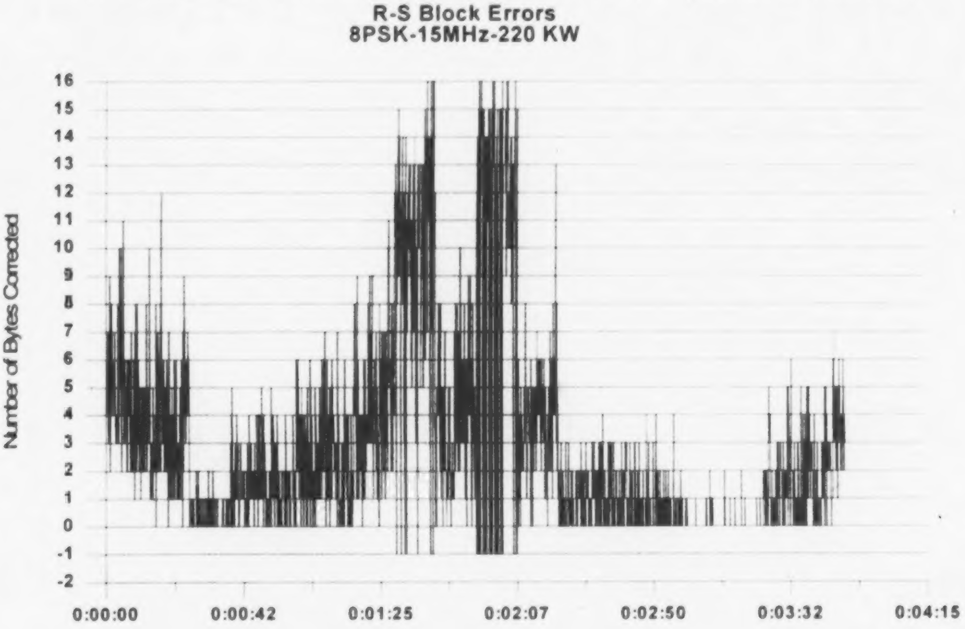


Figure 5. Errors Corrected by Reed Solomon Decoder; September 1997 Test

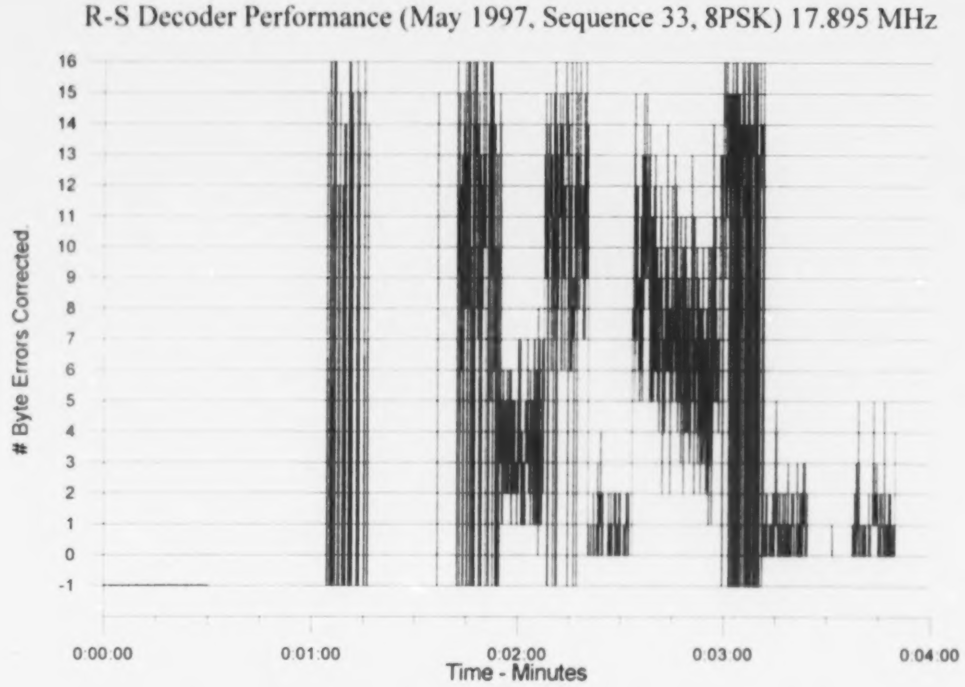


Figure 6. Errors Corrected by Reed Solomon Decoder; May 1997 Test

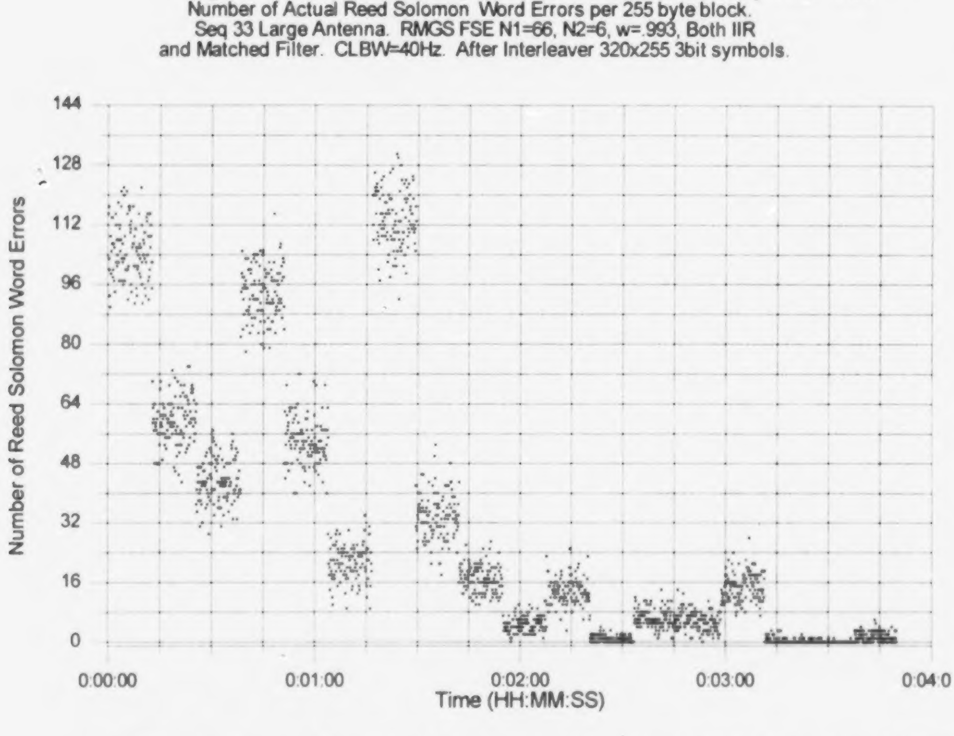
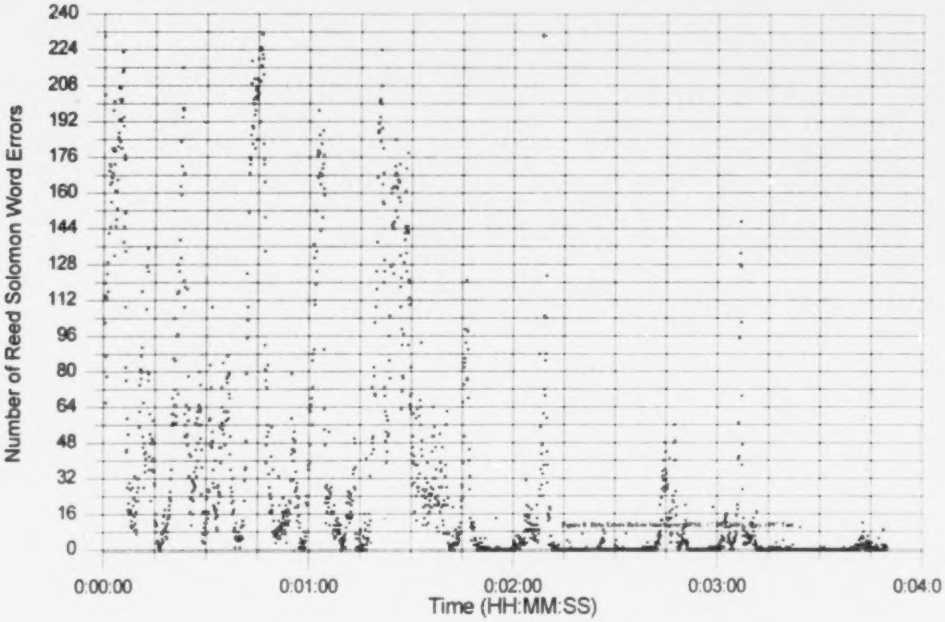


Figure 7. Byte Errors Before Reed Solomon Decoder; 8PSK, 17.895 MHz, May 1997 Test

Number of Actual Reed Solomon Word Errors per 255 byte block.
Seq 33 Large Antenna. RMGS FSE N1=66, N2=6, w=.993, Both IIR
and Matched Filter. CLBW=40Hz. Before Interleaver 320x255 3bit symbols.



An Onboard Processing Digital Satellite-to-Radio Broadcast System

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WASHINGTON D. C.

1. ABSTRACT

In the last half of 1998, WorldSpace will launch AfriStar^{TM}, the first of a constellation of three geostationary orbit direct digital broadcast satellites, to 21° East. An onboard digital processor will allow broadcasters to uplink channels from VSAT earth stations. An onboard demultiplexer-demodulator and routing switch connects 288 uplink channels to one, two or three downlink time division multiplexed (TDM) streams that are broadcasted in three L-band beams. Small personal radios receive and select the channels from the TDM data streams to recover audio, data, and images.

2. INTRODUCTION

Three digital direct broadcast WorldSpace geostationary orbit satellites are scheduled to be launched into locations at 21° over Africa, 95° West over the Americas and 105° East over Asia by the end of 1999.

Each satellite is equipped with three downlink spot beams, having beamwidths of about 6° that can be adjusted in position to achieve optimum coverage of the populations beneath them. Each beam covers approximately 14 million square kilometers within power distribution contours that are 4 dB down from beam center and 28 million square kilometers within contours that are 8 dB down.

The WorldSpace satellites are capable of broadcasting digital radio & multimedia signals directly to small hand-held portable and mobile radios that are in line-of-sight and in one of the three beams.

3. WORLDSPACE SATELLITES

The WorldSpace satellites are being constructed by Alcatel Telecom as prime contractor. The communications payload is carried on a Matra Eurostar 2000+ platform. Sketches of the WorldSpace satellite platform and its antennas are shown in Figures 1 and 2. Some salient features of the satellite are listed in Table 1.

Figure 1. WorldStar Satellite Configuration

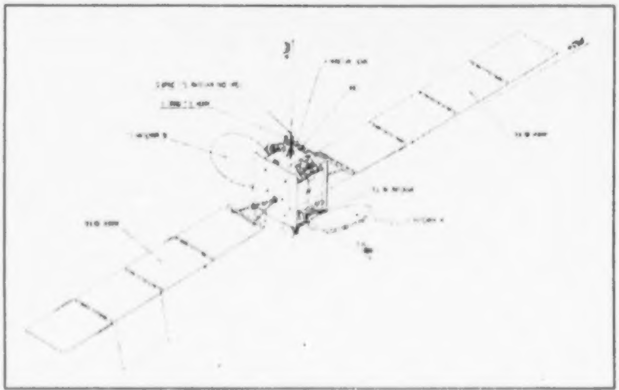


Figure 2. WorldStar Antennas

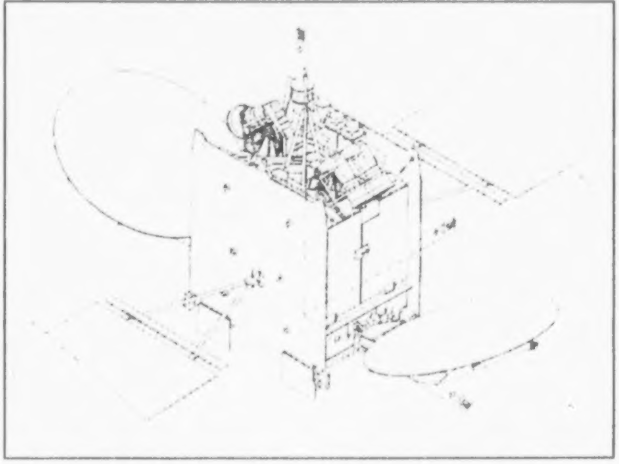


Table 1. Salient Features of the WorldSpace Satellites

Launch Mass	2750 kg for Ariane
Dry Mass	1238 kg
Total Power	4000 W
Solar Panel Span	28 m
Solar Panel Area	49m^2
Antenna Reflector	2.4 m diameter
Apogee Engine	Liquid
Station Keeping	±0.1°
Life Time	12$^+$ years

Power supplied by Nickel Hydrogen batteries will achieve 24 hour operation during eclipses when the satellite falls in the shadow of the earth for a fraction of a day.

Two communications payloads are carried on each WorldStar Satellite. One is a Processing Payload, and the other a Transparent Payload. Each payload supplies three TDM carriers, one to each of the beams as described below.

4. THE SATELLITE BEAMS

The first WorldSpace satellite, AfriStar™, will be located at 21° East directly over North West Zaire. It will direct three pairs of conical beams (one left hand circular polarized (LHPC) and the other right hand circular polarized (RHCP)) centered on the latitudes and longitudes listed below. Each beam has approximately 6° width at its -4dB contour (relative to beam center EIRP) and 8° width at its -8 dB contour.

NE Beam Pair
11.8° N, 35.4°E LHCP
7.9° N, 34.9°E RHCP
NW Beam Pair
21.7° N, 25.5°E LHCP
17.1° N, 25.6°E RHCP
South Beam Pair 3
16.8° N, 0.2°E LHCP
20.8° N, 0.7°E RHCP

The earth coverages for the LHCP beam of each beam pair are shown in Figure 3-a,-b and -c. The earth coverages for the RHCP beams, not shown here, are similar but shifted about 4° of longitude to the south. This angular shift between the LHCP and RHCP coverages is caused by a phenomena called beam-squint that is inherent in combining two opposite polarized carriers into the same feed horn. Within the contour designated as "inner" the signal level will exceed -141.4 dBW/m^2/4kHz and within that designated as "outer" -145.4 dBW/m^2/4kHz. Also shown are the contours within which the line-of-sight elevation angles are greater than 30°, 45° and 60° respectively. Note that most of the inner coverage and a large fraction of the outer coverage are at elevation angles of greater than 30°. At these elevation angles, multipath reflections are at least 15 dB below the direct signal arrival and are insufficient to cause interference to line-of-sight reception.

Figure 3a AfriStar NW Beam

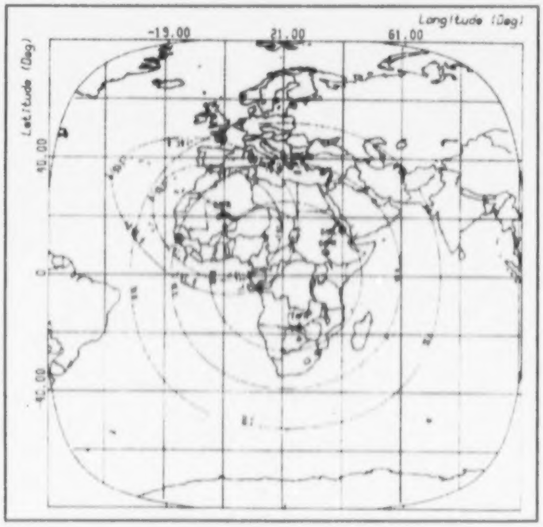


Figure 3b AfriStar NE Beam

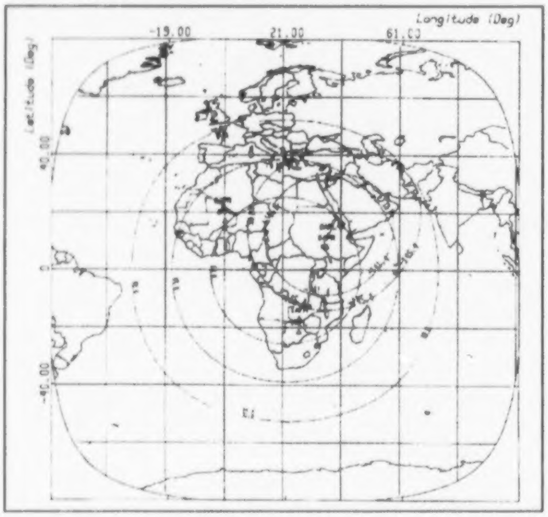
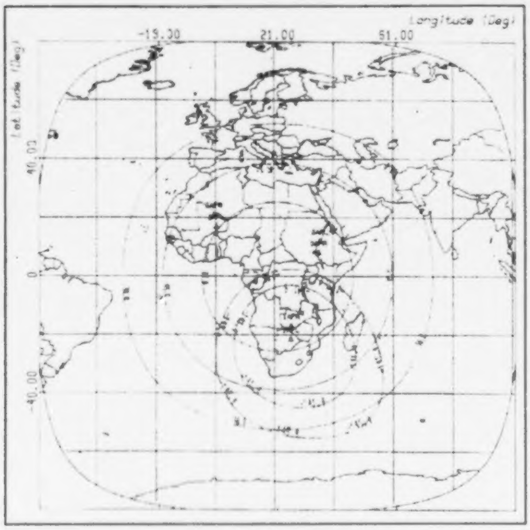


Figure 3c AfriStar South Beam



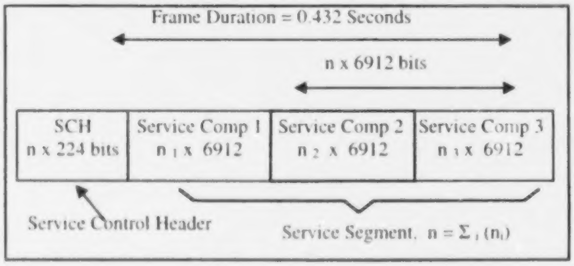
The earth coverages of the beams in the service region of each WorldSpace satellite have been selected to maximize the listener population. Each beam covers approximately 14 million square kilometers within its inner contour and 28 million square kilometers within its outer contour. AfriStar™'s beams cover countries of Africa, the Mediterranean basin and the Middle East. AmeriStar™'s beams cover countries of Latin America and the Islands of the Caribbean. AsiaStar™'s beams cover countries of the interior of Asia and those on the rim of the Pacific and Indian Oceans. Reception is conditioned on locating the WorldSpace TDM carriers in bands of width sufficient to receive a wanted TDM carrier and clear of interfering L-band terrestrial transmissions. Conversely, the Worldspace TDM carriers should not interfere with established terrestrial services. In each case, Worldspace will negotiate appropriate agreements with the administrations so influenced.

In the following discussion, the terms Prime Rate Channel (PRC) and Broadcast Channel (BC) are used. In the WorldSpace system, the traffic is carried in integer multiples of prime rate increments of 16 kbit/s. A PRC is a channel that carries one such increment. A BC combines from one to eight PRCs to carry the services of a Broadcaster. The PRCs, organized into BCs, are carried in time slots in a single TDM carrier in each downlink beam.

5. BROADCAST CHANNELS

Transport over the the Worldspace system is formatted in prime rate increments of 16 kbit/s. From one to eight prime rate increments are multiplexed into Broadcast Channels (BCs). For each prime rate increment, 6192 bits are assigned in a 0.432 sec duration BC frame. These can be divided into several service components in the BC frame. A BC frame, as shown in Figure 4, starts with a Service Control Header (SCH). For each prime rate increment carried in the BC frame, the SCH contains 224 bits. With the addition of the SCH, a BC frame carrying n prime rate increments will contain n x 7136 bits. The SCH provides information needed in the radio receiver to select service components and to allow a service originator to remotely control service related functions. Radio functions thus controlled can include encryption of subscription services, service category selection, addressing subsets of users, displaying messages, enabling and disabling a service, etc. Broadcast frames are assembled at the service origination's facility.

Figure 4. Broadcast Channel TDM Frame



To identify and demultiplex service components, the SCH contains a Service Component Control Field (SCCF) for each service component. This field identifies the type and the length in bits of a service.

After their assembly, BC frames are forward error correction (FEC) encoded first using an outer transport layer R255/223 Reed Solomon Block Interleaved Coder concatenated with an inner transport layer R1/2 Convolution Coder. The outer coder is located at the point of origin of a broadcast channel and the inner coder at the feeder link earth station. The BC frames issued from the outer transport layer each contain n x 8160 bits. If the feeder link station is located remotely, the BC frames can be carried to the stations over leased terrestrial or satellite links using Telco multiplexes. At a feeder link station, for either the processing payload or the transparent payload, the n x 8160 bit Reed Solomon coded BC frames are R1/2 convolutional coded to form n x 16320 bit inner coded BC frames.

6. PRIME RATE CHANNELS

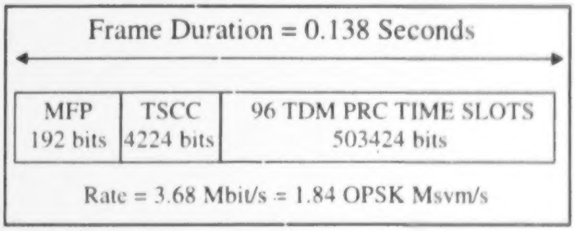
FEC coded BC frames are next synchronously demultiplexed into n parallel PRCs, each containing 16320 bits every BC frame period (0.432 sec). A 96 bit synchronization preamble is added to each PRC frame to accommodate on board rate alignment for the Processing Payload and PRC channel alignment in the radio receiver. Each PRC now contains 16416 bits yielding a bit rate of 38 kbits/sec. These PRCs, carried as service components in the BCs, deliver digital services directly to the radios. How these PRCs are handled at the feeder link stations for transmission to the processing and transparent payloads is discussed in later sections.

7. TIME DIVISION MULTIPLEXING OF THE BROADCAST CHANNELS

Time division multiplexing (TDM) of the PRCs in terms of the BCs is used on the downlinks to the personal radios. In the case of the Processing Payload, the TDM frames are assembled on board the satellite. In the case of the Transparent Payload the TDM frames are assembled at the uplink feeder link stations. For both cases the following description of the TDM frame structure applies.

A TDM frame assembler locates each PRC in one of 96 PRC time slot locations in a 0.138 s duration TDM frame. Each PRC time slot contains 5244 bits and the frame contains 96 x 5244 = 503,424 bits. The TDM frame is shown in Figure 5. Each TDM frame starts with a 192 bit Master Frame Preamble (MFP) followed by a 4224 bit Time Slot Control Channel (TSCC). The MFP and TSCC are used by the radio receiver to synchronize to the TDM frame and to locate the PRCs comprising the various BCs carried in the frame and provide the information needed by a radio to demultiplex the PRCs belonging to a selected BC and to reconstruct the BC.

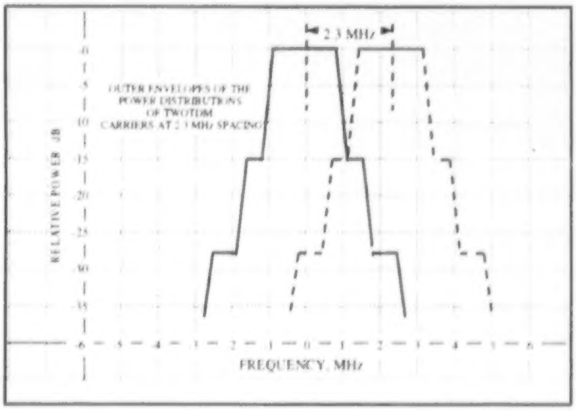
Figure 5. Downlink TDM Frame


Frame Duration = 0.138 Seconds
MFP
192 bits
TSCC
4224 bits
96 TDM PRC TIME SLOTS
503424 bits
Rate = 3.68 Mbit/s = 1.84 QPSK Msym/s

Each TDM traffic stream is divided into 96 TDM time slots each carrying a 16kbit/s prime rate channel at a baseband rate of 1.536 Mbits/s. Due to the addition of service control headers, synchronization preambles and redundancy for forward error correction, the actual bit rate on each downlink TDM stream needed to carry the 96 PRCs is 3.68 Mbit/s. QPSK modulation on L-band carriers at a symbol rate of 1.84 Msym/s (2bit/sym) is used to transport the TDM stream to the radios.

Each WorldSpace satellite is designed to transmit six TDM downlink carriers, three from the processing payload and three more from the transparent payload. One TDM carrier from each payload is transmitted in each beam with opposite polarizations. A frequency spacing of 2.3 MHz between TDM carriers provides sufficient guard band to allow operation with negligible intersymbol and adjacent channel interference at TWTA saturation. The TDM carriers channels are defined by rooted 40 % raised cosine filters with aperture equalization applied on the transmit side. The outer-bounds of the spectra of two adjacent TDM carriers are shown in Figure 6.

Figure 6. Spectrum Bounds For Two Adjacent TDM Carriers



The six TDM carriers of each WorldSpace satellite result in a total capacity of 576 of the 16 kbit/s PRCs. These PRCs, organized into BCs, provide a highly flexible communications highway from direct digital broadcast service providers to millions of users with small personal radios.

8. FEEDER LINK STATIONS

8.1 UPLINKS TO PROCESSING PAYLOAD

At an uplink station to the Processing payload, each PRC, which has been demultiplexed from the BC frame and assigned to its own 0.432s duration frame, is differentially encoded and QPSK modulated onto an IF carrier. Each is up-converted to a center frequency location in the band between 7,025,782,000 Hz to

7,074,992,000 Hz. The center frequencies are located are on a grid having 38 kHz spacings. These are grouped in sets of 48 contiguous PRC carriers having a bandwidth of 1.824 MHz. Up to 26 of these groups can be assigned to center frequencies located on a grid of center frequencies having 608 kHz steps. Only six of these groups, shared by numerous uplink stations, are needed to uplink a total of 288 PRCs to the processing payload on each Worldspace satellite. Thus, there is sufficient uplink spectrum space to flexibly coordinate frequency locations with other services.

The uplink EIRP for each PRC carrier is from 45.7 to 49.7 dBW. When simultaneously amplifying several PRC carriers at a uplink station, their frequency locations should be judiciously spaced to minimize inter-modulation products generated by the non-linearitiy of each feeder link station's high power amplifier.

The uplink PRC carriers are processed on board the satellite to assemble three TDM streams on the downlink.

8.2 UPLINK TO TRANSPARENT PAYLOAD

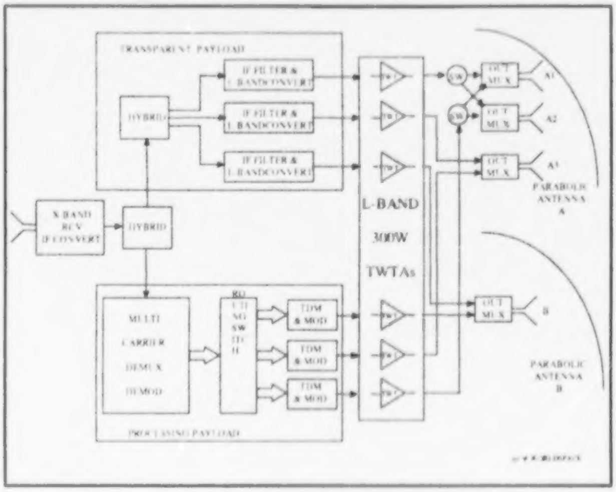
For uplinking to the Transparent Payload, the TDM frame is assembled at the uplink station. It is QPSK modulated onto an IF carrier that is upconverted to a location in the spectrum from 7,025,782,000 to 7,074,992,000 Hz on frequency centers spaced on a grid having 608 kHz steps. Each TDM carrier requires a bandwidth of 2.3 MHz. The uplinked TDM carriers are repeated on L-band downlinks by the Transparent Payload. The downlink TDM carriers precisely duplicate those transmitted from the Processing payload. The radio receiver sees no difference between those emanating from the processed or transparent payload.

There can be one, two or three hub TDM carrier feeder link stations transmitting three, two and/or one TDM carriers. Because the TDM hub stations aggregate a large amount of traffic from many Broadcasters, they use high power amplifiers, large antennas and high EIRP. These hub stations are far larger than the feeder link stations needed for the Processing Payload. However, their economy of scale helps keep the cost per broadcaster down. The typical EIRP for one feeder link TDM carrier is 64.1 to 68.1 dBW. If single carrier per high power amplifier operation is used, high efficiency operation at low back-off can be realized. However care needs to be exercised in selection of the channel filters to minimize induced amplitude modulation intersymbol interference that can be encountered in the high power amplifier.

9. COMMUNICATIONS PAYLOADS

A block diagram of the two communications payloads carried on each WorldSpace Satellite is shown in Figure 7. One is the processing payload and the other the transparent payload. Each payload transmits three TDM carriers each transporting 96 PRCs to small handheld portable and mobile radios.

Figure 7. Worldspace Satellite



9.1 PROCESSING PAYLOAD

The processing payload receives 288 uplink SCPC FDMA carriers each transporting a PRC transmitted from small low power VSAT type feeder link earth stations conveniently placed at or near the premises of the broadcaster. These are carried in six groups, each group comprising 48 contiguous PRC carriers. It down-converts each received uplink group to an intermediate frequency, digitizes the group by means of an analog-to-digital converter, demultiplexes the PRC carriers using a digitally implemented multichannel polyphase processor, demodulates them to recover their basebands, aligns the bit streams to an onboard clock to prepare for routing, routes the bits of each PRC to one, two or three TDM bit stream assemblers, assigns the bits to their appropriate time slots in a 96 PRC time slot TDM frame, issues each of three TDM streams to its' QPSK modulator, up-converters each TDM carrier to its assigned location at L-band, amplifies each to 300 watts via high power TWTA assemblies and then feeds each TDM carrier to one of the three antenna feeds appropriately off-set in its parabolic reflectors to form the downlink beams to the earth. Up to six 48 PRC groups are simultaneoulsy processed in this manner.

9.2 TRANSPARENT PAYLOAD

Each uplink TDM carrier is transmitted to the satellite from a hub feeder link stations located on the earth in line-of-sight of the satellite. The Transparent Payload is equipped with three repeaters that frequency convert uplink TDM carriers, assembled at the feeder-link stations, from locations in the 7025 to 7075 MHz spectrum to locations in the downlink 1467 to 1492 MHz spectrum. In this case, no onboard processing or routing capability is needed.

In each repeater, a TDM carrier is down-converted to an intermediate frequency, filtered through SAW filters having a band pass designed to reject unwanted and accept the wanted carrier spectrum components, fed to an up-converter to locate the TDM carrier at its assigned L-band frequency, then amplified to 300 watts via high power TWTA amplifiers and then fed to one of three antenna feeds off-set in parabolic reflectors to form the downlink beams to the earth. This TDM frame format precisely matches that transmitted from the on-board by the Processing Payload.

9.3 ANTENNA FEED PORTS

Each antenna feed horn has two feed ports, one to accept a Processing Payload TDM carrier and the other a Transparent Payload TDM carrier. The design of the feed horn multiplexer causes the TDM carriers to be radiated in with opposite polarizations and pointed in slightly different directions. This latter effect is referred to as beam squint.

9.4 PROCESSING AND TRANSPARENT PAYLOAD COMPARISON

The following summarizes key differences and commonalties between the processing and transparent payloads.

Regarding the processing payload the following points are noted:

- Achieves 1 dB better end-to-end performance measured in receive margin compared to the transparent payload. This is due to the onboard signal regeneration inherent in the process of demodulation to recover the digital baseband and remodulation which eliminates uplink noise on the downlink carriers, replacing it with a maximum specified uplink bit error rate. The transparent payload only filters, frequency translates and amplifies the uplink TDM carrier. Thus, uplink noise in the carrier's bandwidth is amplified along with the uplink carrier.
- Small modestly priced VSAT feeder link stations, each of which transmits only the small number of the FDMA SCPC FDMA PRC carriers needed to deliver its broadcast channels, are used to uplink to the processing payload The power required is only that needed for its traffic.

- The SCPC FDMA PRC carriers can be assigned to any of the uplink locations in the six 48 PRC carrier groups assigned in the uplink frequency spectrum. The frequency assignments can be changed if necessary to avoid uplink interference.

- An onboard routing switch permits any uplink SCPC FDMA PRC to be routed to any one, two or three of the downlink TDM carriers. This provides a highly flexible onboard traffic routing capability that permits any small VSAT feeder link to reach any and all of the downlink beams of each satellite

Regarding the Transparent Payload, the following points are noted:

- The format of the TDM downlink carriers is the same as that for the processed payload. The radios will not experience any difference other than a reduction of receive margin by 1 dB caused transparent repeating rather than onboard regeneration of the uplink signal.

- The TWTA power output is the same as that for the Processed Payload generated TDM carriers, viz. 300 W.

- In each satellite region, there may be three separate hub stations, each organizing and transmitting one TDM carrier, or there may be two with one organizing and transmitting two and the other one TDM carrier, or there may be one organizing and transmitting all three TDM carriers. The precise choice of hub station deployment will be determined by need.

10. RADIO RECEIVER PROCESSING

10.1 RADIO OPERATIONS

Up to six downlink TDM carriers from various beams may be received by the radio one at a time. Each TDM carrier is composed of contiguous frames of 138 ms duration initiated by a Master Frame Preamble (MFP). Each frame is divided into time slots that carry 96 prime rate (16.518 kilobits per second) channels. Each frame has a Time Slot Control Channel (TSCC) which contains the information needed by the radio to locate and

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demultiplex the PRCs of a any BC and to identify the beam and TDM carrier.

Each radio receiver, can tune to any one of the TDM carriers transmitted in one of the beam coverages. It first demodulates the bits, synchronizes to the TDM frames and recovers the TSSC. Using the TSSC information, the tuned beam and carrier are identified and the PRCs are demultiplexed are recombined to recover user selected BCs.

A Service Control Header (SCH) of each BC contains information needed to select desired service components from the broadcast channel, to route the components to specific decoders to recover the service, to send text messages and labels to a liquid crystal display in the radio.

The recombined coded program channels thus recovered are decoded and de-interleaved to recover the original baseband prime rate bit stream that entered the system at the broadcaster's earth terminal. The recovered bit streams are next converted back to the analog audio signal by a source decoder.

The radios can reproduce various audio qualities ranging from AM monaural to CD stereo depending on the program channel bit rate. The table that follows lists the various quality options available in terms of the program channel bit rate required.

Table 2. Bit Rates For Various Program Channel Qualities

Quality	kilobits/sec
Better Than HF(AM Monaural)	16
FM Monaural	32
FM Stereo	64
Near CD Stereo	96
CD Quality	128

The bit rates and consequently qualities can be mixed in any beam to meet the demand for service. The bit-rate can be easily changed from ground command and can vary at different times of the day.

The radio receiver tunes by automatic search to downlink TDM carriers having center frequencies located from 1467.184 to 1490.644 in steps of 0.460 MHz.

10.2 LINE-OF SIGHT RECEPTION BY SIMPLE PORTABLE RECEIVERS

At elevation angles ranging from as low as 30° to as high as 85° direct line-of-sight signals will be easily received indoors through windows and outdoors by simple modestly priced yet highly sensitive receivers At elevation angles lower than 30°, direct line-of-sight signals will be received indoors through windows and outdoors where there are no strong multipath interferers. At very high elevations , say greater than 85°, line of sight outdoor reception will be widely possible, but indoor reception through windows will be difficult unless the building is made of material that is nearly transparent at L-band. In the latter cases, a passive 1.5 m x 1.5 m square metallic surface positioned to reflect line-of-sight received signal through a window should be sufficient to establish indoor reception at distances up to 5 m. In any case, whenever direct line-of-sight indoor reception is blocked, a simple outdoor antenna (a yagi or helix with 4 to 8 dBi gain) placed in line-of-sight and connected to a shielded indoor repeater amplifier radiating about 100 microwatts can provide excellent indoor reception.

10.3 RADIO PERFORMANCE

The system is designed to deliver a post FEC decoder BC bit stream with a Bit Error Rate (BER) lower than 10^{-4} at the radio. The margins for this operation as a function of the radio's Gain to Noise Temperature ratio (G/T) for the Inner and Outer coverages for TDM signals arriving from the Processing Payload are given in Table 3.

Table 3 . Operation Margins For The Processing Payload as a function of Radio Receiver G/T

Radio Receiver G/T (dB/K)

	-11	-13	-15	-17
Inner Coverage	11	9	7	5
Outer Coverage	7	5	3	1

The margins for TDM carriers coming from the Transparent Payload are 1 dB less than those given in Table 3.

The radios are also equipped with an antenna port to attach, by means of a cable, an external antenna located at a convent place in the line-of-sight.

Non-blocked line-of-sight reception is always possible even for mobiles at speeds of over one hundred miles per hour. Under partial blocked conditions reception is possible within the inner contour provided the blockage loss is with in the limits cited in Table 3.

Digital Sound Broadcasting - Announced Implementation Plans in the Pacific Rim

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ABSTRACT

Generally, sound broadcasting systems share common frequency bands (allocations) throughout the world. Consequently, there is also great interest in finding common spectrum for the implementations of Digital Sound Broadcasting (DSB) systems. Terrestrial broadcasters in various administrations are considering the use of parts of the HF,MF, VHF and UHF bands, as well as the new allocations to the Broadcasting Service at L-band (1452-1492 MHz) and S-band (2310-2360 MHz and 2535-2655 MHz). For satellite DSB, administrations are examining the latter three bands which were also allocated at the 1992 World Administrative Radio Conference (WARC-92) to the Broadcasting Satellite Service (Sound).
Since WARC-92, a number of administrations have conducted extensive testing of both terrestrial and satellite DSB systems, followed by a formal announcement of implementation plans. There has also been an announcement of the planned introduction of an international DSB service.

INTRODUCTION

DSB programming from terrestrial and satellites directly to listeners in mobile vehicles, primarily automobiles, trucks and motor homes and in homes and offices are expected to be available before the beginning of the 21st century. DSB will initially operate in one of three bands allocated at WARC-92. They are 1452-1492 MHz, 2310-2360 MHz and 2535-2655 MHz. DSB service will provide listeners with a diversity of radio programming: agricultural, local, domestic and niche programming for rural areas, and educational and cultural programming on a nation-wide basis. Technical development, manufacturing and industrial development is also foreseen. Providing a high quality DSB service mandates that service outages be extremely infrequent.

DSB Implementation Requirements

Each country approaches DSB with its own unique set of requirement(s):

1. mode of delivery (terrestrial only/satellite only/satellite and terrestrial)
2. Announced frequency plan and spectrum use, and
3. Planned Programming.

These combined factors for each country yield a unique implementation timetable, frequency/spectrum plan and programming plan preferred for implementation.

DSB Implementation Plans for the Pacific Rim

This document has attempted to capture all of or a majority of the announced plans of the Pacific Rim Countries[1] and International Systems which call for a variety of implementation schemes and plans. The most likely and first to appear would be the implementation of commercial terrestrial-based system in two to four years. Implementation of satellite-based systems, or mixed terrestrial/satellite systems could be expected in four to six years.

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[1] Defined to include all countries that border on the Pacific Ocean.

Countries with Announced Plans

CANADA

Canada has announced that it intends to implement a terrestrial Digital Audio System in the new L-band BSS allocation beginning in late 1997, utilizing the Eureka 147 System. On July 28, 1995, Industry Canada issued Notice No SMBR-003-95 entitled "Adoption of a System Standard for Digital Audio Radio Broadcasting (DRB) in Canada" for terrestrial transmission. Canada plans to replace all existing AM and FM radio stations with Terrestrial Digital Audio Broadcasting (T-DAB). Extensive terrestrial testing has been conducted during the period 1994-1997 in Montreal, Toronto, Ottawa and Vancouver. The Canadian Government is expecting to have available sufficient receivers for service introduction. Frequency coordination discussions have been ongoing with the United States for several months now. For further information see paper by Trenholm.

MEXICO

Mexico in July 1995 conducted L-band satellite system tests using their Solidaridad 2 Satellite and the Eureka 147 Digital Audio Broadcasting System in the suburbs of Mexico City. This test was the first time the Eureka 147 system has been used for direct reception from a satellite. Both fixed and mobile receivers were used in the Mexico City test. Recent information received through the United States State Department indicated that Mexico has changed its initial plans for DSB from an L-band (1452-1492 MHz) system to an S-band (2310-2360 MHz) system. Detailed implementation plans are not known at this time.

UNITED STATES

In the United States the Electronics Industry Association/Consumer Electronics Manufacturing Association conducted a laboratory analysis of various systems that might be utilized in DSB service offering. In August 1995 the results of laboratory measurements of DSB system performance were presented. Approximately, one year later in December 1996 the Field Test Data from experimental transmissions in the San Francisco, California area were presented. Currently industry organization are studying the two reports. The Federal Communications Commission (FCC)in January 1997 allocated the band 2310-2360 MHz for satellite-delivered Digital Audio Radio with associated Gap Fillers. In April 1997 the FCC auctioned the band 2320-2345 MHz for Satellite DSB. The two winners were CD Radio, Inc. and American Mobile Radio Corp. Both have received their licenses from the FCC and have announced implementation plans that would bring DSB into service throughout the continental United States around late 2000 or 2001. For further information see paper by Briskman. Work is ongoing in the development of both In Band On Channel (IBOC) or In Band Adjacent Channel (IBAC) that would be used inconjunction with the current terrestrial AM and FM radio stations.

ANDEAN COUNTRIES (Bolivia, Columbia, Ecuador, Peru and Venezuela)

The newest DBS/DTH-related DSB initiative within the Pacific Rim countries is the Simon Bolivar satellite. This proposed satellite will be operated by the countries of the Andean Pact (Bolivia, Columbia, Ecuador, Peru and Venezuela) and will be used to provide telecommunications and DBS/DTH services to these countries, and to the rest of Latin America as well. Although this initiative is still in the planning stages, its organizers are moving quickly to put a plan into place, and to sign a contract to manufacture the satellite. Implementation is several years away.

AUSTRALIA

Australia in June-August 1995 conducted L-band test using their Optus B Satellite and the Eureka 147 Digital Audio Broadcasting System in various cities in Australia. Both

fixed and mobile receivers were used in the Australian test.
The Minister of Communications indicated in August 1995 that the cities of Melbourne, Sydney and Brisbane would each get a Digital Audio Broadcast transmitter by August 1996.
It is planned to have a two phase introduction of DSB. Phase 1 will be the terrestrial implementation and Phase 2 will be the implementation of satellite delivery. It is anticipated that existing AM and FM operations will not be affected.

CHINA

China began testing of a terrestrial based German platform in December of 1995.
China has indicated that it is planning a combined Digital Audio Broadcasting and Digital Television network. However the investment required to implement both systems may be too expensive and only the Digital Audio Broadcasting will be implemented in the near term. Little else has been published about the Chinese plans.
A lot of work is currently ongoing in China directed toward developing solutions to the multipath environment

JAPAN

Japan Satellite Systems Inc. a subsidiary of Toshiba Corporation and 11 other firms plan to launch digital satellite broadcasting for automobiles by year 2000. The service is described as offering 30 to 40 channels on dedicated portable terminals, similar in size to existing car navigation systems. Proposed service include a wide range of radio and TV programming including live sports, weather forecasts and traffic conditions.
A lot of work is currently ongoing in Japan in developing various transmission schemes, coding techniques and receiver development.

INDONESIA

Indonesia indicated that in 1995 it conducted a series of DSB tests from its L-Band domsat. Results of that testing have not been made available in the open literature.

INDIA

Indian DSB services are currently planned in three phases. In the first phase, ie. by year 1998, terrestrial DSB service in VHF simulcast mode will be initiated in a limited scale in four metropolitan cities (New Delhi, Bombay, Calcutta and Madras). The regional programs will be collected at New Delhi via satellite contribution links and subsequently distributed from New Delhi via S-band transponder of INSAT. DSB signals will be received, converted to VHF band II and simulcast using the existing FM transmitting antenna and tower. In the second phase, independent local transmitter transmitting a mix of local, regional, national and sponsored programs, will be gradually added to a number of FM stations by year 2003. Finally, satellite DSB services could commence after the year 2003. Terrestrial transmission will be in VHF Band II and the satellite emission will be in L-band.

INTERNATIONAL SYSTEM

WorldSpace Inc. founded in 1990 is proposing to provide a "digital direct satellite radio broadcasting service to the emerging yet under-served market regions of the world"[2]. The WorldSpace network will consist of three satellites in geostationary orbit serving the African-Arab region including the Mediterranean Basin, the Asian Region and the Caribbean and Latin American regions. Two of the three satellites of the WorldSpace System will have direct access to the Pacific Rim Area with service beginning in late 1998 and mid 1999. WorldSpace will use a receiver designed for their system called "Starman". WorldSpace has indicated in their literature that they will have sufficient receivers in the market place for their service. For further information see paper by

---

[2] WorldSpace Web Site

Campanella.

CONCLUSIONS

An initial survey of the current plans reveals that, at this time, there is little consensus emerging among administrations on what frequency band(s) should be used for terrestrial DSB service but there is a growing interest in implementing systems. From the information available at this time, broadcasters and regulators are looking at a number of terrestrial broadcasting bands ranging from MF to UHF using techniques such as IBOC, IBAC, in addition to the satellite/terrestrial DSB bands allocated in WARC-92.

NOTES

1 Defined to include all countries that border on the Pacific Ocean.

2 WorldSpace Web Site.

Creating a Billing and Customer System to Cope With Convergence of Telecommunications Services

by
Christopher Thomas
Chairman
Chorleywood Consulting Ltd.
UK, Europe

Convergence is a current theme of telecommunications services supply around the world. Managing the billing for and customer support for convergent services is the theme of this paper, focussing on providing a high level of customer care.

It is wise to begin this discussion by making a number of definitions in order that we have a clear understanding as to what we understand by convergence and how this needs to be addressed in billing and customer care.

Convergence in telecommunications may involve the provision of multiple services by a single service provider or network operator; these might include:

> Wireline Telephony
> Telephony of itself is a group of service which, aside from POTS, might include Centrex or ISDN, or more advanced intelligent network based services.
>
> Wireless Telephony
> Mobile telephony is becoming more sophisticated by the year and has now incorporated many of the type of services provided by the wireline networks - such as closed user group services.
> Fundamentally mobile services provide for user roaming and possibly for international roaming.
>
> Cable Television
> Geared towards entertainment, this group of services is becoming more sophisticated through the provision of user defined services such as video on demand and pay per view.
>
> Advanced Interactive Services
> Frequently provided by the cable operator, but more sophisticated services including access to entertainment services such as interactive games, and business services such as video conferencing or broadband access to the internet.
>
> Of course there are many other diverse services which might be included in this list from access to the internet, through LAN interconnect, to wireless data services.

But convergence might involve the provision of other, more diverse, services as the following examples illustrate.

> Electricity, Gas and Water Utility Services
> Basic wireline telephony is becoming a commodity service required by the mass population,

as well as gas, water and electricity, and in some countries is being delivered by multi service providers.

Financial Services - Banking
Banks have excellent customer information and can settle accounts by electronic transfer of funds. They are therefore ideal business partners for telecom service providers seeking to cultivate profitable business.

Providing multiple services to a single account has many benefits to the service provider:

- Better Account Control
- Reduced Billing Costs
- Reduced Collection Costs
- Potential for Cross Service Discounting
- Cross Service Loyalty Schemes - Tools for Customer Retention.

and to the consumer:

- Single Bill for Multiple Services
- Reduce Payment Costs
- Simplification of Payment
- Volume Related Discounts on the Whole Bill.

It would be naive to perceive that these advantages are gained without some potential drawbacks. These include the possibility of:

> 'Bill Shock' whereby the user, previously receiving several small bills at different dates in the calendar, receives a single bill which he or she cannot, or will not, pay.

> The allocation of funds in the instance of partial bill payment - should one or more services be terminated because of partial payment.

In reality such problems can be addressed by suitably tailored procedures within the service provider, but I bring them to your attention so that you can think them through and formulate your policies - before being confronted by these problems!

Let me move on to give some real examples of the value of convergence in the marketplace. Examples are influenced by local traditions and business conventions. One practice which is popular in one country will not necessarily be appropriate to another. Nonetheless examples will stimulate your thoughts and maybe generate ideas. In a competitive market there is a challenge to telcos and service providers to tailor their services to particular groups of users. Some examples illustrate this.

Around the world there are mobile traders. They might be electricians, plumbers or builders, or second hand car dealers. These individuals want seamless service in telephony such that when at their base, they can receive wireline calls, or when away from their base, they receive their calls over a wireless telephone - the caller being aware of only one telephone number. A useful extension of this service is that of an electronic voice mail service, such that when the trader is busy on a job, messages are recorded for his or her attention when available to speak with the contact. It is perhaps obvious to say that this group of users wants a single bill for all the services which are described above, and a single point of telephone contact with a service provider to sort out questions which might arise concerning service or billing.

Many residential telephony customers also buy cable television service. It may well appropriate for these customers to receive a single bill for both telephony and cable television. This is particularly true where services are being offered which combine these communications tools: for example the ordering of a 'pay per view' video over the telephone from the cable television company. Or the participation in a local television show over the voice telephone line.

There are large numbers of SOHO (Small Office Home Office) residential offices in many countries. A high proportion of the workforce is becoming home based, for part or for all of the working week. Such user groups can be practically addressed by two wireline connections - or a single ISDN basic circuit. One line provides for voice telephony and can be enhanced in value through the addition of call waiting or voice messaging. The other provides for a data service, either with a fax machine or through Internet access. Combining the wireline service with peripheral equipment - 'phone and fax' - together with a rapid repair service in the event of a fault offers a high value integrated service to the customer.

Mobility appeals to the user of telephony services. It is now possible for a mobile instrument to act as a cordless telephone on a home or office base station, and to act as a cellular telephone while roaming away from the primary site. The user of the mobile will pay diverse rates for making or receiving calls depending on the tariffing principles of the service provider. It may be that callers to the user dial one single number to reach the specific user while at his or her primary place of residence or work, or when roaming. In this case the service provider is exploiting technology to provide a seamless service to the customer using the intelligence of the network and advanced billing techniques.

Another group of customers we call I3s. These are Information Intensive Individuals. They require access to the internet and their personal or corporate data and messages wherever they are around the world. Often members of this group carry laptops around with them and want easy access to the telecommunications network and a single consolidated bill.

What are the implications for billing and customer care of these developments in service convergence?

Each type of service provided by telecommunications operators has specific issues. A few examples will illustrate this point:

> Fraud is of major concern to mobile operators. This can take two main forms. Firstly the electronic cloning of telephones; secondly the use of false identities to procure service.
>
> Similar issues surround the provision of calling card services.
>
> In the instance of cable television, issues surround the access of

minors to adult channels.

Billing and customer care systems reflect the service types for which they are designed:

Cable television billing systems are designed around an address or location.

Mobile telephony billing systems are designed around an individual.

Business telephony billing systems are designed around accounts which may include multiple locations in order to facilitate volume discounting.

It is unlikely that operators or convergent service providers will seek to build a fully integrated multiple service billing system. Frankly this would be far too complex. Rather they may exploit multiple billing engines, see Presentation Diagram 9, each tailored for the specific service, with the option to present the customer with separate bills for each service, or with an integrated bill for multiple services, should the customer require this option. Overall co-ordination of the account will be provided by the billing integrator.

The effort to coordinate multiple systems into an integrated billing solution should not be underestimated. It is likely that each account will be allocated an overall reference number to facilitate the consolidation of information from multiple sources. Specific checks and balances will be required to avoid bill duplication or the loss of data - and revenue! While generic billing engines such as Geneva and rating engines like Prospero are designed to facilitate multiple service billing within an overlay solution, it is likely that a systems integrator such as Andersen Consulting or CAP Gemini will be employed to undertake the integration of diverse systems.

It is likely that it will be at this overlay level that overall discounts and benefits will be calculated, the subsidiary systems providing event records and basic rating of the data. With such a solution, consideration must be given as to the location of the customer record archive, and the systems which customer care agents should access when handling a query on a customer account.

An alternative approach is to purchase a billing solution which is specifically designed to bill for diverse services. One of the most broad based systems which is available internationally is ICMS from IBM. Based on the billing system of New Zealand Telecom which focusses on wireline, IBM has developed the package to bill for wireless, cable television and other diverse services. Further the software has proven ability to bill several million customers.

Such systems must also have the ability to receive payments from customers - or to trigger automatic payment. Many service providers collect their bill from customer credit card and bank accounts using automated processes. Discounts may be give to users in order to gain their permission to collect revenue in this way.

To date consolidated billing experience has been, in the main, limited to those organisations such as Concert and Uniworld, who offer international services on a 'one stop shop' basis. Complexity due to multiple currencies and exchange rates together with multiple language support and time zone differences illustrate the real difficulties which these organisations face.

Similar issues will face other organisations attempting to introduce convergent billing.

Additional consideration must be given to the provision of adequate customer care for multiple service customers and as to how this can be organised and supported. Presentation Diagram 9 illustrates the diverse aspects of customer care from sales enquiry to fault handling.

Care agents handling customers with diverse service types will need to have access to and be familiar with the various customer care and billing systems to which they make reference, whether this involves access is to multiple individual systems or through a single integrated front end.

Very careful consideration should be given as to how customers of multiple services should be handled. In the UK Barclaycard, a VISA credit card issuer, and Cellnet, a cellular operator, have integrated customer care, the user being transferred between call centres through the user of a single keystroke by a customer service agent. In this case, the credit card issuer is responsible for customer credit rating and account management, freeing Cellnet to develop and manage its network - the business it knows best.

Offering users multiple services opens up many possibilities for account development and reduction in customer churn. Existing customers can be approached to sell them service types which they may not be yet using. Special incentives might be offered to existing customer to try a new service type or combination. Each of these possibilities can be efficiently implemented through the use of the billing and customer care system and associated call centres.

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CREATING A BILLING & CUSTOMER SERVICE TO COPE WITH CONVERGENCE OF TELECOMMUNICATIONS SERVICES

PTC'98

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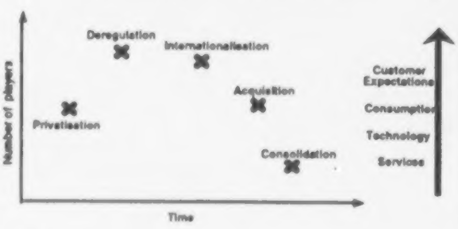
by

Christopher Thomas
Chairman

Chorleywood Consulting Ltd

Telecom Industry Evolution



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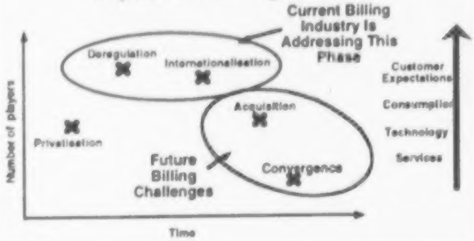
Impact On Billing Industry



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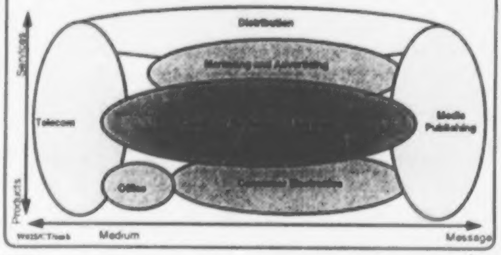
Convergence Between IT Sectors Promotes Alliances


Services
Products
Distribution
Marketing and Advertising
Telecom
Media Publishing
Office
Consumer Electronics
Medium
Message

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Examples of Cross-Industry Alliances:

Ericsson & Hewlett-Packard (EHPT)

US West & Time Warner (Time Warner Cable)

Cellnet & Barclaycard (special handsets, services, billing etc)

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New Telcos May Come From Many Backgrounds

Utilities (Energis, RWE, Norweb)
Transport (Hermes, Swire)
Banks (Banco Santander, Banco del Lavoro)
Computer companies (Olivetti, IBM)
Manufacturing (Pohang Iron & Steel)

This will encourage the billing of cross industry services on one bill

BEST COPY AVAILABLE

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Convergence in Billing

One Bill For:

Mobile + Terrestrial	-	Telia
CATV + Telephony	-	CWC
Fixed, Mobile, Internet	-	MCI

And in the Future for:

All Utilities	-	Energis

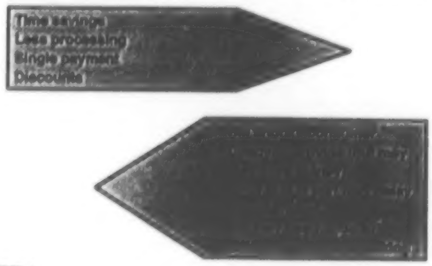
Note Simplification in Payment
Cheque Free

W025/CT/web

Presentation 7

Chorleywood Consulting Ltd

Bill Consolidation - For & Against


Time savings
Less processing
Single payment
Discounts

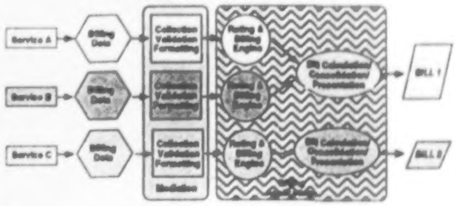
W025/CT/web

Presentation 8

Chorleywood Consulting Ltd

Integration of New Services in Existing CCB Architecture

Consolidated -v- Single Service Billing


Service A
Billing Data
Collection Validation Formatting
Rating & Billing Engine
Bill Calculation/ Consolidation/ Presentation
BILL 1
Service B
Billing Data
Service C
Billing Data
Collection Validation Formatting
Rating & Billing Engine
Bill Calculation/ Consolidation/ Presentation
BILL 2
Mediation

W025/CT/web

Presentation 9

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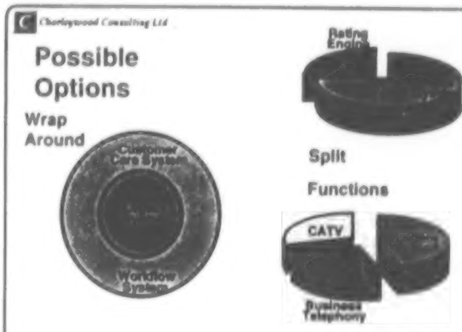
Possible Options

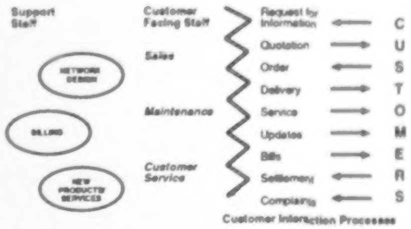

Wrap Around
Customer Care System
Workflow System
Rating Engine
Split Functions
CATV
Business Telephony

W025/CT/web

Presentation 10

Chorleywood Consulting Ltd

Customer Interaction Processes


Support Staff
NETWORK DESIGN
BILLING
NEW PRODUCTS/ SERVICES
Customer Facing Staff
Sales
Maintenance
Customer Service
Request for Information
Quotation
Order
Delivery
Service
Updates
Bills
Settlement
Complaints
C
U
S
T
O
M
E
R
S
Customer Interaction Processes

W025/CT/web

Presentation 11

Chorleywood Consulting Ltd

Consolidated Services Require Unified Customer Care

- Move from "silos" to cross-service functions
- Move from product-centred to customer-centred
- Use of systems to enable CSRs to handle queries accross many services and many issues
- Segmentation of the customer base to provide care levels appropriate to the value of the customer
- Corporate customers served by dedicated teams

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Presentation 12

SHARED CORPORATE SERVICES
Achieving Savings and Service Excellence

T.J. McKeown
Vista Group International

Kenneth C. Malley
U.S. Department of Treasury

1.Abstract

This paper describes a proven methodology for strategically planning and implementing an information technology Shared Services environment over a corporate network. It addresses the benefits being derived through the quiet revolution of convergence by developing high performance, user-focused applications and services that achieve savings and an "inside" competitive advantage.

2. Introduction

Shared Services is a forward thinking strategy that can transform internal staff and business processes to achieve significant operational performance improvements and cost reductions. Through Shared Services all levels of organizational entities benefit. The business goals and operational missions of diverse but related corporate entities can be connected through a strategic planning process that will bring together common needs for services. During the planning process, the definition and scope of Shared Services will then equate to the essential requirements of the corporate business base. The key features of this paper describe a corporate process for planning, developing, managing and implementing Shared Services. The authors are using a Corporate Shared Services model at the U.S. Department of Treasury in order to explore the role of Shared Services within an existing corporate setting and discuss experimental evidence in place at a major, complex government organization. This government organization is not unlike its counterparts in the private sector regardless of size or national affinity, since it still must discover and meet customers demands, within a competitive, cost effective environment and under the constant scrutiny of its citizen stockholders. The objective of this paper is to make a strong case for the economic significance of creating Shared Services inside a corporation and how to go about it. Therefore the focus of the reader's attention should be on the innovative processes of developing and managing Shared Services, the types of services defined and the exciting benefits that can be derived, unbiased by government or commercial predilection. The convergence of communications, computers and content can be exemplified through a process of planning, developing, managing, implementing and monitoring Shared Services for the corporate advantage

3. The Planning Process

At the outset when planning is discussed, it is incredulous nowadays to think in terms of traditional long range planning or short range planning. That kind of planning drastically falls apart in the face of rapidly accelerating change. Since the single most competitive competency challenging corporations today is how to manage change or "change management", corporations are discovering that the only type of planning stepping up to this formidable task must first embrace fundamental issues in strategy formulation. So it is strategic planning that is firmly grounded in practice today, that allows companies to define corporate goals or Visions to be achieved through a fundamental process of developing issues and Strategic Directions. In strategic planning while the Visions are relatively stable, the strategies are flexible and can be quickly adjusted to cope with today's environment of relentless change. Rather than becoming confused and tossed about in a sea of severe change, strategic planning

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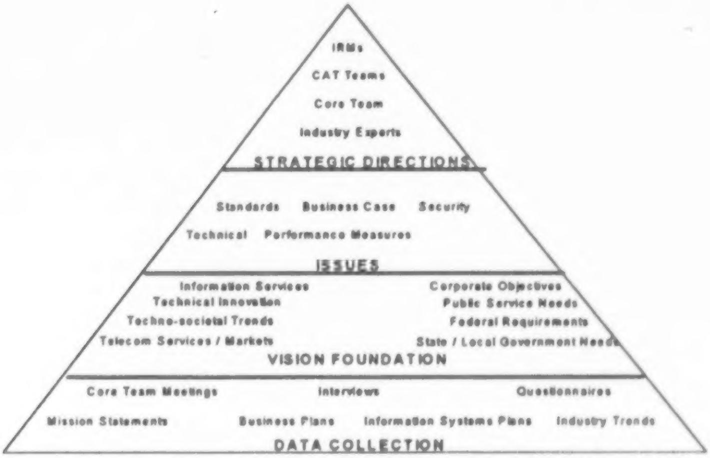
builds a framework for reaching goals and attaining corporate Visions.

Strategic Directions are specific courses to follow while continually navigating through the obstacles and issues that eventually lead to goal achievement.

The pyramid illustrated in Figure 1 shows a process for developing Strategic Directions. Beginning with a base of data collection and analysis, Visions or goals are stated, issues are identified for reaching each of the Visions, and finally the Strategic Directions are defined for solving the issues.

We have concluded that the strategic planning process to identify and define Shared Services begins with four essential elements: (1) top management involvement, (2) cross-functional team-based corporate planning, (3) a user or customer-driven focus, and (4) a proven process with objective facilitation. The following is a brief description of the Four-Phased Process that produces a Strategic Plan while encompassing the steps and results needed to develop the Strategic Directions.


IRMs
CAT Teams
Core Team
Industry Experts
STRATEGIC DIRECTIONS
Standards
Business Case
Security
Technical
Performance Measures
ISSUES
Information Services
Technical Innovation
Techno-societal Trends
Telecom Services / Markets
Corporate Objectives
Public Service Needs
Federal Requirements
State / Local Government Needs
VISION FOUNDATION
Core Team Meetings
Interviews
Questionnaires
Mission Statements
Business Plans
Information Systems Plans
Industry Trends
DATA COLLECTION

(Fig. 1 Development of Strategic Directions Four Phases)

The Process

Phase One:

- **Data Collection Process**
  A methodical procedure for obtaining all strategic planning data.
- **Define The Corporate Visions**
  Review, analyze and evaluate the results of the data collection process. Derive and understand corporate business goals, then define the corporate visions.
- **Identify The Issues**
  From the data collection process, identify issues affecting the realization of each vision.

Phase Two:

Short Term Recommendations

During the data collection process, certain situations are discovered that offer near term benefit. The data collected often reveals high leverage opportunities that should be acted upon immediately.

Phase Three:

Strategic Direction Development
After the issues are identified strategic directions are developed, which will resolve the issues and bring about the realization of the visions. New initiatives are defined, policies are proposed, technologies and standards are selected.

Phase Four:

Strategic Plan Drafted

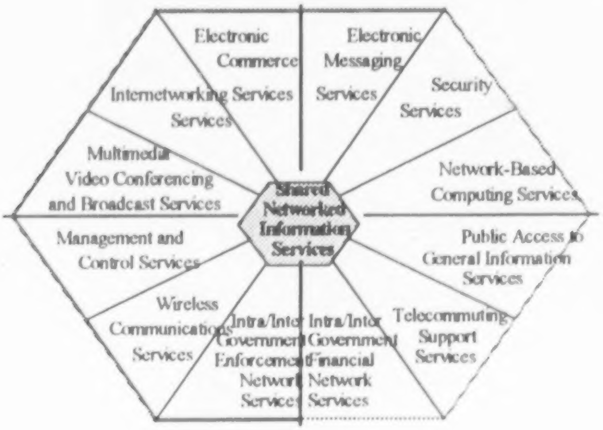
The Strategic Plan reflects all the results of the Process and clearly articulates the Visions, Issues, Strategies, Technologies selected, the implementative consideration and the methods for Assessing Progress.

In Phase One, the external and internal drivers are identified that affect the requirements for the types of Shared Services that are to be developed and the potential customer base. The external drivers include technology trends, competitive factors, cost of acquiring outside services for each corporate entity, costs of consolidating and outsourcing, and the cost-benefit of consolidating and performing internally. The planning team carefully reviews the missions, corporate goals, business plans and operational needs of each division or agency (corporate division or subsidiary) to identify the types of information services (Visions) that would meet current and future requirements of their respective organizations. The team collects and analyzes all pertinent data through a variety of means including interviews with top management and a credible sample of cross functional business users. The analysis process in our project lead to the development of Visions and Vision statements of capabilities for a variety of Shared Services.

4. A Vision of Various Shared Services

From a total of 25 Visions, unconstrained by technology considerations or costs, our cross-functional corporate team settled on 12 Visions for Shared Services as shown in Figure 3. Issues associated with achieving these Visions were identified in team work sessions. The Issues reflect the challenges, obstacles and concerns to be addressed before transforming a Vision or goal into reality. Issues have significance on a number of different dimensions, such as policy, technology, organization, operations, cost and culture. The specific actions for solving the issues that lead to the achievement of each vision became the Strategic Directions.

The following paragraphs describe the Corporate Visions for Shared Services derived by the planning team from their analysis of business processes and objectives, their interviews with all pertinent management and user resources, and their identification of common, critical operations that can be supported now and in the future by Shared Services


Shared Networked Information Services
Electronic Commerce Services
Electronic Messaging Services
Security Services
Network-Based Computing Services
Public Access to General Information Services
Telecommuting Support Services
Intra/Inter Government Financial Network Services
Intra/Inter Government Enforcement Network Services
Wireless Communications Services
Management and Control Services
Multimedia Video Conferencing and Broadcast Services
Internetworking Services

(Fig. 2 Strategic Visions of Shared Services)

(1). Electronic Commerce Services

Vision Statement

Electronic Commerce Services offer an integrated (EDI and Web) set of IT capabilities that users may adapt to reengineer procurement, payment, invoicing, shipping, warehousing and tax-related business processes, thereby increasing productivity, reducing paperwork, and saving time in transacting business with trading partners.

The plan for sharing Electronic Commerce services calls for all Corporate Divisions or sub-entities, vendors and other trading partners to process solicitations, purchase orders, invoices, contract amendments, payments, warehousing, shipping and receiving on corporate-wide EDI and Web-based systems. Due to its prominent position with respect to international trade and the banking industry, EDI is well positioned to be the focus for these automated Electronic Commerce activities. However, the Internet and Web-based technology is dominating in most other vendor to customer business transactions.

(2). Electronic Messaging Services

Vision Statement

Electronic Messaging Services will build the essential infrastructure to link all users , creating a communications media that exemplifies all the advantages of convergence, the information age and the knowledge worker.

The sharing of Electronic Messaging Services will enable protected and secure access to the Internet, World-Wide Web, and bulletin board/kiosk information resources for the benefit of the corporation, its personnel and customers. It can leverage the connectivity offered by the company's intranet, Internet Service Providers and public carriers to increase bandwidth availability and reduce cost. A Shared Service can operate and manage directory services, certification, authentication, firewalls and establish services that will convert facsimile, voice mail and other media to allow communication between disparate systems.

(3) Internetworking Services

Through Internetworking Services, corporate users will freely interoperate with multi protocol networks and applications, taking full advantage of information resources external and internal networks using accepted national standards, security features and protocol conversion as necessary.

Internetworking Services will allow the creation of virtual private networks between affinity groups, based on different missions, business functions, products and customers; all sharing a common information infrastructure. Also, promoting integrated, sharing of inter-division or agency data, data warehousing, applications and processing capabilities. Internet access is provided along with appropriate firewall protection.

(4). Security Services

VISION

The integrity, confidentiality, and availability of the corporate network and those information resources, products, and activities encompassed within the corporate IT domain will be ensured be Security Services, with full accountability to the level of the individual user and/or transaction.

Security Services are critical to ensure the availability, integrity, and confidentiality of information contained within the corporate network and at information sources connected to the network. Marketplace trends show increasing recognition that encryption and authentication mechanisms, such as smart cards and digital signature, are necessary to reduce the vulnerabilities associated with distributed networks. A permanent Security Team is needed to audit and immediately detect and correct security compromises. Also this Security Team should make frequent risk analyses, approve all corporate security systems and conduct training.

(5). Network Management and Control Services

VISION

Corporate users will benefit from proactive problem isolation, diagnostics and dynamic reconfiguration of network facilities and help desk problem solving capabilities for all common IT systems and applications. This will allow a composite view of the entire corporate information infrastructure with segmented domain administration and service privileges as required by user communities.

Network management products that represent the "best of breed," should be selected rather than opting for a single source provider of all management products. The best management system will be a heterogeneous mix of software products guided by a unified standards process.

(6). Intra/InterGovernment Financial Network Services

VISION

Treasury will enhance its leadership role in the virtual networks created by local, state, and Federal government entities by using Intra/Intergovernment Financial Network Services to electronically deliver benefits, process tax- and duty- related information, and coordinate a full range of banking activities

Evaluate, in particular, the Simplified Tax and Wage Reporting System as an example of intra/interorganization cooperation. Select the initiatives within the commercial EDI conventions relating to financial transactions that could be incorporated into the Shared Service.

(7). Multimendia, Video Conferencing Broadcast Services

Corporate users will select convenient desktop and group alternatives for information exchange, conferencing, and training, by selecting from an extensive array of state-of-the-art technologies, available through Multimedia/Video Conferencing Broadcasting Services.

The network architecture to support Multimedia/Video Conferencing Broadcast Services should follow user applications and be the natural derivative of user requirements. Operational efficiencies, economies of scale, and management control can be improved through the use of Shared Services. The service offerings of the will address the ability of the user organizations to accommodate bandwidth demands. Coordinate the use of public carrier alternatives to increase available bandwidth as cost- effectively as possible.

(8). Network-Based Computing Services

Vision

Network-based Computing Services will empower corporate users with access to a menu of information applications & computing resources tools, through value-added Services that include standards-based messaging and directory capabilities, shared databases, and security protection.

Corporate users and customers will realize information management efficiencies and plethora of services by centralizing computing resources within a common network. For users, this set of capabilities will infrastructure as a truly service-based utility. Evaluate the inclusion of specific service offerings on the basis of results from experimental implementation, such as pilot programs, proofs of concept, and model/simulations.

(9). Public (Customer) Access To Government (Corporate) Information Services

Vision

Corporate users will respond to American public's desire (Customer need) for user-friendly, accurate, and confidential access to Government (Corporate) Information Services by using different combinations of Shared Service capabilities.

Public Access to Government Information and Services will support the "outreach" aspect of an Electronic Government, to better serve the U.S. citizen and disseminate information more easily

and efficiently, using a variety of communications media. Establish the Internet and World-wide Web (WWW) as primary methods of supporting customer access to government (corporate) information. Provide 800 services, kiosks, and bulletin board access as required. Define an Information Service Management Center infrastructure and design a technical architecture for distributing and controlling access to information and services designated for customers or the public.

(10). Intra/Intergovernment Enforcement Network Services

(NOTE. THIS SERVICE MAY NOT HAVE APPLICABILITY TO COMMERCIAO CORPORATIONS BUT IT IS VERY PERTINENT TO INTERNATIONAL GOVERNMENTS.)

VISION

Intra/Intergovernment Enforcement/Network Services will leverage the best available information technologies to coordinate and achieve successful investigative and enforcement activities at all levels, including international.

These services are essential for meeting mission enforcement objectives within and across jurisdictional boundaries in a cost-effective manner. All government agencies whose missions involve enforcement activities will benefit from services that enable coordination with local, State, Federal, and international organizations.

Partition this Shared Service into subnetworks to accommodate the special needs of the enforcement community. The partition must be able to support multiple levels of security, user access control, and wireless communications. Make maximum use of existing legacy equipment and databases. Establish an International Enforcement Network Group to identify the required information, databases, and desired product of an integrated Information Infrastructure for enforcement and investigative purposes.

(11). Wireless Communications Services

VISION

Users will require interoperable, transparent, and secure Wireless Communications Services to pursue corporate business processes regardless of geographical location, mobility, natural disaster and emergency conditions, desired application, or preferred communications media.

Wireless Communications Services will facilitate remote access to data, voice, messaging, and extended LAN capabilities. Wireless capabilities are critical to mobile personnel conducting various activities, such as sales, repair work, installation, site visits, etc, Wireless also answers certain operational needs for telecommuting.

(12). Telecommuting Support Services

VISION

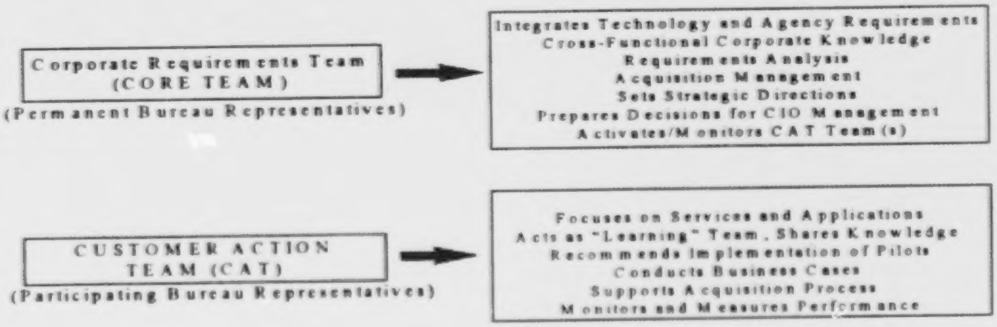
Telecommuting Support Services will promote and support collaborative work efforts by linking corporate users at dispersed locations, including employee home sites, thus increasing productivity, maintaining essential business services under exceptional circumstances, and encouraging employment of individuals covered under the Americans with Disabilities Act.

Telecommuting Support Services will offer a solution to environmental, socio-cultural, and business continuance issues that revolve around establishing alternative work sites. Studies indicate that significant cost and productivity advantages can be gained by allowing telecommuting as a work process option. For example, employees could work from home or from a satellite center close to home, rather than travel to a more distant corporate facility.

5. Managing the Migration to a Shared Services Environment

The predominant driver that gets things moving toward a new work environment of Shared Services is the strength of consensus developed by an employee-based, cross-functional planning team. We call this team a Core Team. It is at the center of all planning, but it is also a corporate requirements team and a Shared Services integration team. This team must be truly convinced of their findings that Shared Services will be useful to them and the corporation and it is equally important that senior management advocacy be made obvious to the team. For our purposes, team members possessed technical and business knowledge of corporate functions, locations and operations. They had a working knowledge of the companies mission, policies, current corporate services and future plans. Members had experience in recommending strategic directions to senior management and could quickly gain guidance and approval.

A strategic management approach for migrating to a Shared Services environment was built around the Harvard Business School text book "*Fundamental Issues in Strategy*" written by Rumelt, Schnedel and Teece.


Corporate Requirements Team
(CORE TEAM)
(Permanent Bureau Representatives)
Integrates Technology and Agency Requirements
Cross-Functional Corporate Knowledge
Requirements Analysis
Acquisition Management
Sets Strategic Directions
Prepares Decisions for CIO Management
Activates/Monitors CAT Team(s)
CUSTOMER ACTION
TEAM (CAT)
(Participating Bureau Representatives)
Focuses on Services and Applications
Acts as "Learning" Team, Shares Knowledge
Recommends Implementation of Pilots
Conducts Business Cases
Supports Acquisition Process
Monitors and Measures Performance

(Fig.3 Decision Management Structure)

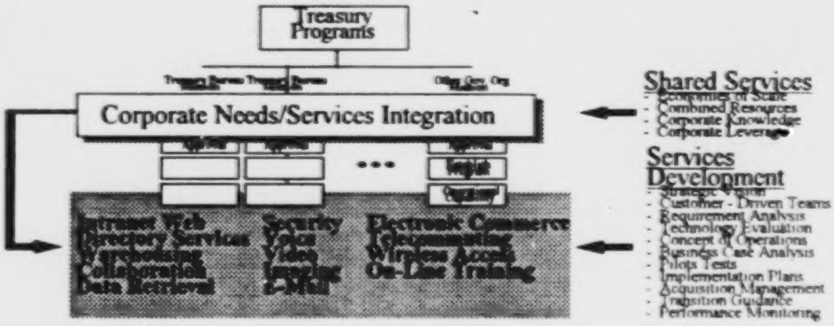
Therein the authors recommend: (1) design a decision management structure, (2) leverage enterprise knowledge, (3) define goals, (4) choose an appropriate level of scope, and (5) select and test systems or services. Figure 3 shows a model Decision Management Structure and briefly defines responsibilities. The following paragraphs will address the other recommendations.

6. The CORE Team/CAT Team Process

The Core Team/CAT Team process is a strategic management approach devised by the authors for systematically absorbing, responding and infusing evolving technology and new requirements into the development and delivery of corporate Shared Services. CAT Teams are Customer Action Teams of cross functional users or customers dedicated to the life cycle development and performance of a specific Shared Service. A team oriented, customer-driven management structure focused on leveraging enterprise knowledge, each CAT team shares experiences and acts as a "*Learning Team* as explained in "*The Fifth Dimension*" by John Engle. Under the guidance of the Core Team, a cross sampling of customers and technologists are encouraged to join a CAT Team. In some instances, customers may be enlisted through an incentive program, but surprisingly most customers are willing to participate and are quick to offer suggestions, knowing they will be heard. Each CAT Team gains customer-driven results. They focus on making strategic directions happen and they seek new applications for their business processes. When a new idea arises that may have merit from a business case point of view, CAT Teams recommend pilot testing to the Core Team and monitor implementation and progress. CAT Teams prepare performance measurements and scorecards for their Shared Service, and conserve time by employing Web-based, intranet, collaborative applications among themselves and the Core Team whenever possible. A great example of an active team in today's information age is a Shared Service CAT Team dedicated to Telecommuting. It is working extremely well in our government model, combining technology requirements such as; telecommunications connectivity and data processing with a plethora of knotty management issues to solve. The Core Team/CAT Team process has been in effect for over a year in our model, and it is an exciting management approach that is producing emergent corporate strategies arising spontaneously from innovations never anticipated or intended.

7. Corporate Shared Services Development Process

Within the corporate enterprise, each Division or Bureau will have unique mission related programs that may or may not lend themselves to corporate sharing of services. Figure 4 shows that each bureau in our model(or commercial Division) submits its service program needs up the line where they are compiled for a total review of an enterprise-wide IT budget. However, during this process when requirements are filtered and analyzed through a Core Team charged with strategically identifying common corporate needs, Shared Service requirements will emerge that may become obvious candidates for achieving cost savings and competitive advantage through economies of scale in management and implementation.


Treasury Programs
Corporate Needs/Services Integration
Intranet Web
Directory Services
Warehousing
Collaboration
Data Retrieval
Security
Voice
Video
Imaging
E-Mail
Electronic Commerce
Telecommuting
Wireless Access
On-Line Training
Shared Services
- Economies of Scale
- Combined Resources
- Corporate Knowledge
- Corporate Leverage
Services Development
- Strategic Vision
- Customer - Driven Teams
- Requirement Analysis
- Technology Evaluation
- Concept of Operations
- Business Case Analysis
- Pilots Tests
- Implementation Plans
- Acquisition Management
- Transition Guidance
- Performance Monitoring

(Fig. 4 Corporate Shared Services Development Process)

Employment of a structured Shared Services Development process begins with participatory strategic planning, as explained earlier, concept formulation and requirements analysis. Figures 9 and 10 are flow charts depicting the several stages our model employs for developing and monitoring a Corporate Shared Service. The essential elements of this process entail the following: (1) Concept Definition and Service Design, (2) Business Case Development and Review, (3) Service Development and Pilot Testing, (4) Acquisition and Implementation Planning, (5) Service Implementation and Migration, and (6) Post Implementation Review. Creating an effective team environment that is focused on customer service and on deriving a return on investment is the most significant contribution to the success of the process. The Customer Action Teams must be completely involved. This is not only important for the birth of a Shared Service, but for its entire life cycle. When the service is in full swing, the CAT team is monitoring its performance using performance measures created by them. If the team is not satisfied it should be empowered to require corrective action. As technology and requirements change, the CAT team refreshes the life cycle of the Shared Service. The CAT Team and its Shared Service are inseparable.

(8) Summary

The key business technique for governments and companies to successfully cope with the new world of "convergence" will not be to engineer big technological breakthroughs; but to be capable of managing relentless change and

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developing new products and services by creatively combining rapidly evolving technology with customer needs and performance measurements. Innovation is the key competency of the new knowledge based corporation, and innovation in business today requires collaboration among those who may see the world differently, but team management if done properly lets conflict take place constructively. Shared Services managed by an empowered Core Team/CAT Team process can be applied externally as well as internally to profit through customer input and the fundamental issues of strategic planning.

REFERENCES

1. "Realizing the Information Future" National Research Council, National Academy Press, 1995

2. Druker, Peter; " Managing for the Future" November 1993

3. Naishitt, John; "Global Paradox" January 1995

4. "Fundamental Issues in Strategy" Rumelt, Schendel and Teece, Harvard Business School Press, 1996

5. Smith, Douglas K. "Taking Charge of Change", March 1996

6. Smith, Douglas K. "The Wisdom of Teams" 1995

7. "An Improvisational Model for Change Management, The Case of Groupware Technologies", Wanda J. Orlikowski & J. Debra Hofman, Sloan Management Review, M.I.T. Winter 1997

SPOT MARKET FOR BANDWIDTH

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Abstract

Arbinet Communications Inc. plans to operate the spot market for the communications industry with its Global Clearing Network which is operating today. Arbinet firmly believes that the replacement for the international settlement and operating agreements between countries and carriers will be a combination of a VisaTM type credit Clearing Network between switches owned by different carriers and an airline type yield maintenance system. This Clearing Network will allow carriers to exploit their existing networks by allowing them to manage their excess bandwidth in real time on a per call basis.

The New York Times, Monday August 4, 1997
Watch 800 Companies Stuff Themselves Into One Phone Booth
"…the transmission and the provisioning of long-distance service is pretty much of a commodity operation, like grown wheat."
(Show Overhead of Article: Summarize article on the position of the top 10 Global carriers and how they want to stop the other 790 from further eroding the global long distance market)

The Economist, August 30th 1997
Commoditising telecoms – Pork Bellies Calling
"…in late June, the two have built what amounts to the first international commodities market in telecoms, a "bandwidth exchange" called Band-x based on the internet."
(Show Overhead of Article: Summarize article and how a clearinghouse for commercial companies has changed the way they purchase minutes from carriers)

The Economist, September 12th 1997
" …one day in 1993, Alex Mashinsky, a young Israeli with a background in commodity trading, suddenly realised that, around the century's end, conditions would be ripe for a spot market for international telephone capacity…"
(Show Overhead of Article: Summarize article on how the clearinghouse concept is here now and being implemented!)

This clearing house concept creates the opportunity for a *Spot Market for Bandwidth* which has arrived due to many reasons, some of which are the excess bandwidth capacity currently available within many national and international carriers network's creating a wholesale market for Trans-border services. Deregulation and privatization have brought in literally thousands of new competitors. Investments in growth oriented foreign communications systems. These and other reasons contribute to the market drivers for a *Spot Market for Bandwidth.*

The growth of the communications industry has been fueled by the realization of the internet, enhanced services like callback, fax bypass, pre and post paid calling cards, along with the high growth in Local Exchange Carriers subscriber penetration. Wireless communications, mobile office environments, tele-commuting, and e-mail have enabled large corporations to downsize staffs while increasing dramatically their communications requirements. Financial transactions over communications networks have changed the way banks and investment firms do business. E-trading, ATM cash machines, and debit bankcards are now the standard for a growing majority of financial transactions. These services will require larger and larger volumes of bandwidth from the existing global bandwidth pool. A recently concluded contract for a $1 billion commercial company's Voice communications needs required 5 months of negotiation for a rate that was not the best rate at the time of contract signing. In the era of a *Spot Market for Bandwidth*, that transaction would be completed in minutes, and re-negotiated on a daily or on demand requirement based on current rates and origination and destination locations.

The United States representing over 80% of the world's Internet traffic reached a milestone during the month of May, 1997. The number of data calls on the voice network surpassed the number of voice calls for the first time in the history of telephony! All this on a voice network designed to carry only 5% of data traffic. Alternative on demand resources for Internet traffic are required to insure that users of the Internet do not get a busy and have the best response possible. This means carriers will have to spend Billions to re-dimension the data traffic or risk losing their licenses due to poor Quality of Service issues.

While a great deal of sound and fury has been directed at schemes to utilize the Internet and other data routings to circumvent the existing switched network infrastructure, remarkably little effort has been made to properly utilize and manage the trillion dollars in existing infrastructure. As part of a *Spot Market for Bandwidth*, carriers will be able, for the first time, to intelligently manage their network bandwidth and costs by publishing to the Clearing Network the rates and times for which it wants to transit and/or terminate other carriers' traffic.

Enabling a *Spot Market for Bandwidth* requires a centralized approach to the sale and purchase of this excess bandwidth capacity. This need for on-demand (near real-time), pricing and acquisition of bandwidth must be made available to carriers who have a pre-approved financial capability, and network quality to take advantage of the sale and purchase of large volumes of bandwidth at *Spot Market for Bandwidth rates*. Least cost routing of traffic plays a major roll in availability and rates for the *Spot Market for Bandwidth* that by its very nature, is dependent on a Clearing and routing Network.

One approach to distributed access of a centralized clearinghouse for bandwidth exists today in a rapidly growing communications network environment. This paper addresses the approach to the demands of global carriers requiring quick access to national carrier networks with alternative access possibilities. Perhaps this connection came about from other requirements, but it is here today to enable a Clearing and routing Network for a *Spot Market for Bandwidth*.

One way for this new Clearing and routing Network to happen is with a highly communicative telephone switch operating as an overlay network directing the existing trillion dollar network, and having that same switch economically deployed worldwide in areas without an existing integratable infrastructure.

Arbinet firmly believes that the replacement for the international settlement agreement and operating agreements between countries and carriers will be a combination of a Visa™ type credit Clearing Network between switches owned by different carriers and an airline type yield maintenance system. This Clearing Network will allow carriers to exploit their existing networks by allowing them to manage their excess bandwidth. For example the average usage of a major carriers international network is around 17%. This infrastructure cost in excess of $100 BN to put in place. Despite this huge number of, by analogy to the airlines, "empty seats", there is no means of yield management more efficient than offering lower night and weekend rates. There is no mechanism of offering transport to other carriers, or, for example, routing a call in the late afternoon US time when circuits between say Japan and the US may be full, via unused evening capacity on US/Europe/Japan links.

What needs will drive carrier participation in a *Spot Market for Bandwidth*?
Are requirements for large volumes of Internet Traffic clogging your voice network?
Do you have requirements for large volumes of traffic on a national and international basis that would benefit from reduced costs?
How do you stay competitive with enhanced services that drive large volumes of bandwidth, like Fax, Pre-Paid and Debit Card programs?
Have you identified large volumes of traffic to and from international destinations?
Are your settlement payments out of balance? Are you a wireless carrier with significant origination settlement payments?
Is your network underutilized most of the day (24-hour period)?

What if a carrier could meet these requirements by a centralized clearinghouse network allowing instant access to the sale and purchase of excess bandwidth?
Allowing carriers to review on-demand, the rates for standard large volumes of traffic.
Allow carriers to lock in those rates most favorable to current requirements at a QOS (Quality of Service) customer's demand.
Allow carriers to split requirements to take advantage of a smaller volumes of bandwidth than required, but in total provide all the bandwidth requirements and at better than current rates.

584

What if this Centralized Clearinghouse network allowed carriers to post rates for excess network capacity? Rates that would attract consumption and bring incremental revenues for network resources previously idle.
What ROI (return on investment) rate would be suitable to gain access to this centralized clearinghouse network? 2 years, 1 year, how about 3 months?
What if your largest competitor was participating in the *Spot Market for Bandwidth*, yet this participation allows you to make substantial revenues and profits using its network resources at great rates, purchased through the clearinghouse network.

Assuming a Solution to the *Spot Market for Bandwidth* clearinghouse existed today, what would it look like and how would it work for global carriers. This clearinghouse would allow for real-time purchase and sale of telecom minutes at the lowest price available for a given guaranteed QOS. It should allow the potential to provide alternate access connections like IP networks between participants in the clearinghouse, thus utilizing data networks and freeing voice networks for the purpose they were designed. Quick and easy access to the central clearinghouse server for updates of posting sell and buy orders would be provided after qualifying each new participant.

As additional carriers join the clearing house network, their route prices will immediately be included in the rate offerings, and give participating carriers quick access to new network capacity and new rate possibilities. The new participants will also be able to take advantage of available bandwidth at posted prices. An Internet network will be enabled between participant's countries and regions. Therefore all participants gain an instant incremental advantage to being part of this clearinghouse network. Carriers now gain an advantage in operating at lowest cost transport, which give carriers an ability to compete for new customer's traffic while keeping existing customers happy.

With even a modest number of initial participants, the ability of the network to exploit arbitrage opportunities will dramatically lower the costs and routing of participating carriers. On a Foreign county/US route for example, the rate would be $.10 per minute lower than current rates. This rate would not only capture almost all of the traffic flowing to foreign country from the US, but it would also capture traffic from Europe to foreign country via refile in the US, and additionally, a great deal of traffic to other destinations and into neighboring foreign country via refile through foreign country. Once this begins, carriers will either join and compete, or suddenly find hundreds of minutes of traffic disappearing literally overnight.

Another example would be a carrier with 1 million minutes to a destination at current competitive rates taking immediate advantage of a second carrier joining the clearinghouse network and offering its excess bandwidth from the same origination to destination point at a greatly reduced price. The original carrier can now increase profit margins on demand, offer its end-user customers a better deal on rates hoping to increase usage, or offer new enhanced services at great rates to drive up usage volume.
Rapid changes and improvements in technology are driving the fast pace to a *Spot Market for Bandwidth*. PC based switching, adherence to telecommunication and computing standards and higher price performance from computer systems are some of technologies enabling solutions to this emerging market for a clearing house network.

Satellite Interference Reduction

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Mark Morgan, Customer Advocate, Loral Skynet®
Dave Morgan, Customer Service Manager, Loral Skynet®

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ABSTRACT:

With the use of satellite communications expanding globally, satellite operators must adopt measures to fight interference problems. Interference causes degradation in signal quality that can have a negative economic impact. The satellite community must work together to ensure an interference free product which is in demand worldwide.

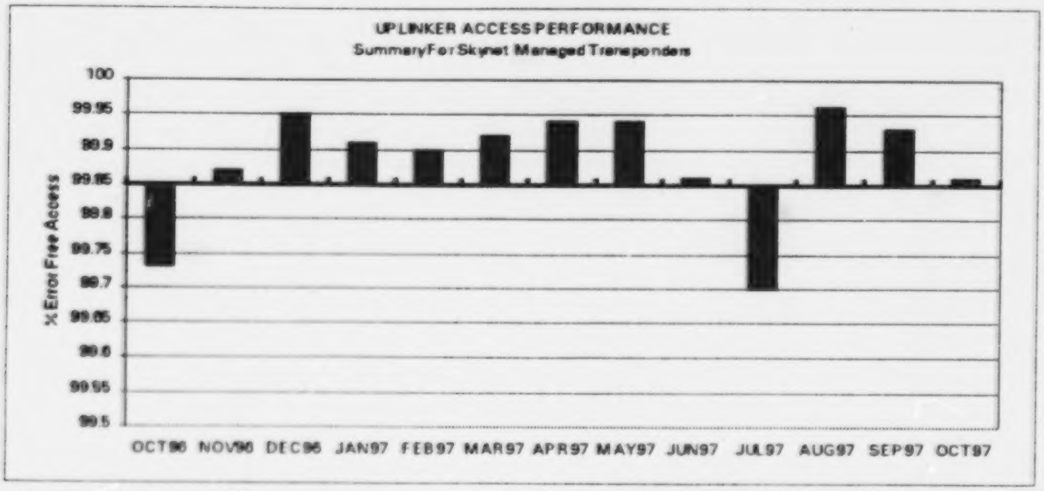
Use of satellite communications is expanding globally. This expansion, coupled with the high costs involved with satellite transport, has put satellite transmission services at a premium. When satellite users are required to pay this premium price for their services, interference goes beyond being a nuisance; it becomes a costly service degradation. Satellite service providers and satellite operators must work together to combat interference not only to increase transmission quality, but also to allow for greater financial growth of the satellite industry. To defray some of the high costs of using satellites, many users are turning to occasional transmissions for their satellite transport needs. However, occasional use, which supports many diverse market segments including news, sports, entertainment, syndication, business television, and distance learning, tends to be a haven for interference if left unchecked. While the service providers and satellite operators carefully control most of the transmissions, occasional transmissions require a collaborative effort among teleports, fixed earth station operators and transportable operators. To ensure value in the market, satellite service providers must provide a quality, interference free product. Many companies, including Loral Skynet, have implemented programs to help educate, train, and sometimes force operators to comply with interference reduction techniques.

Interference is quite minimal from fixed earth stations, those that do not move their antenna once the services are established and for which the antenna is locked onto a given satellite, is quite minimal. The long-term nature of the services, coupled with careful control by the satellite operators, including intercarrier frequency planning and coordination, ensures consistent quality performance. However, interference still can occur. Many users are pushing the envelope of useable transponder capacity as they strive to reduce their overall network costs including space segment and ground segment. This increases the link's susceptibility to interference. The costs involved with controlling the interference may then be greater than the overall network cost the user was trying to achieve.

Many users are turning to occasional use services to reduce satellite transmission costs. However, occasional services are the subject of most concern due to the nature of the transmissions as well as the transportable and flyaway uplinks used to provide these services. While these uplinks are staffed with professionally trained technicians, improper satellite access or operation may occur. This can happen for any number of reasons, including urgent broadcasts of news or sporting events. This urgency can cause improper satellite access, resulting in either intersatellite or intrasatellite interference. This can affect not only the transmission of the interfering party, but also the transmissions of customers on the serving satellite or on an adjacent satellite.

Loral Skynet's objective is to achieve a 99.85% success rate with our uplinkers. The chart in Figure 1 indicates the percent of error free accessing to Loral Skynet managed transponders. The chart covers the period from October 1996 through October 1997 measured against Loral Skynet's 99.85% objective.

Figure 1



While the 99.85% objective has generally been achieved over the 13 month period, the overall performance can always be improved.

In order to reduce, or at least minimize, the costly effect of interference, a number of programs can be implemented. The programs fall into two categories: preventive or demand. The preventive programs are designed to encourage training and educating operators and technical staff. The demand program is designed to quickly stop interference by identifying the offending site and requiring an immediate power down of the transmitter. Any of these programs, when used effectively can help defray the costly effects of interference throughout the satellite industry.

Preventive Programs

The preventive programs include: Satellite Users Interference Reduction Group (SUIRG), access management, uplinker management and Loral Skynet's Uplinker of the Year Award.

SUIRG

The Satellite Users Interference Reduction Group consists of all major US domestic satellite service providers, as well as many international satellite service providers. The main focus of this industry group is to reduce interference among satellite services through: establishing cooperative relationships among all satellite operators; sharing of interference experiences and resolutions; developing industry-wide access and training procedures; and developing improved methods of locating interference sources.

The most recent SUIRG meeting was held in Jakarta, Indonesia in October 1997. This meeting clearly established the international scope of interference considerations to satellite operators worldwide. This is particularly important in Asia where there is less than two degrees of separation between satellites. In this region, new operators with limited experience and speaking many languages present challenges to operators. Developing inter-operator cooperation internationally must be made a priority if the satellite industry is to continue its global expansion.

The SUIRG meeting concluded that the need for international coordination is a necessity. It is important that all operators recognize the need to insure a trouble and interference free environment. New operators and language differences create challenges to be met in the satellite industry.

It is important that as many operators as possible support the SUIRG and its mission. Satellite communications quality must be improved to ensure continued global expansion.

Access Management

The intent of Loral Skynet's access management program is to provide uplinkers clear and precise information that allows safe and efficient access to the Telstar satellites. The Access Management

Manual is a guide that includes information regarding the Telstar satellites, uplinker obligations, access procedures, technical parameters, Loral Skynet contact lists and customer earth station profiles.

Uplinker Management

Uplinker management involves educating both current and new uplinkers and ensuring they receive Loral Skynet's Access Management Manual. If interference occurs, Loral Skynet calls the interfering party to review the details of the incident and determine how to eliminate future occurrences. This information is then shared with any affected customer.

Uplinker of the Year Award

Loral Skynet established the "Uplinker of the Year" award program to reduce interference by awarding those uplinkers who had perfect access performance for an entire year. Loral Skynet implemented this program in 1991 to promote user education and training, ensuring an interference free environment for users of Loral Skynet and adjacent satellites. For the seven years that Loral Skynet has funded, maintained, and promoted the "Uplinker of the Year" program, users of the Telstar satellites have aggressively supported this program, and welcome the industry recognition and rewards for excellent service.

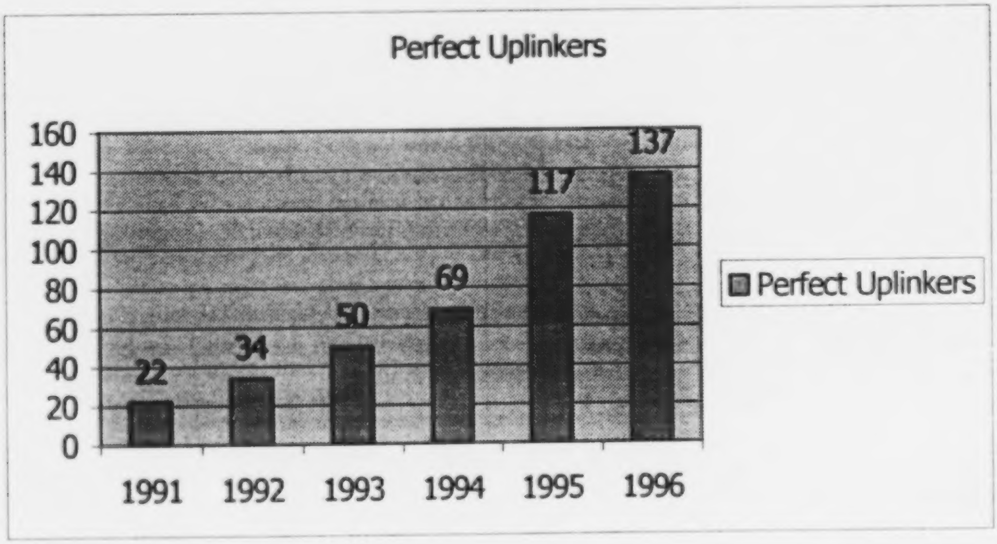
To qualify for an "Uplinker of the Year" award, each company must demonstrate perfection (100% error free accessing in the calendar year). Each winner must have a year long, incident free access record as recognized by the Loral Skynet Satellite Control Facility located in Hawley, Pa. The "Uplinker of the Year" awards are divided into three categories depending on the user's frequency of access: Gold, Silver, and Bronze. Gold is awarded for 1000 or more accesses, Silver is awarded for 251 - 1000 accesses, and Bronze is awarded for 50 - 250 accesses.

Loral Skynet recognizes all "Uplinkers of the Year" for their outstanding achievement with a certificate, a gift, and a special reception held at the National Association of Broadcasters (NAB) meeting in April of each year. Recipients typically highlight receiving this award as part of their marketing and sales strategy. The recipients' names are also displayed prominently at the Loral Skynet booth at the NAB.

The "Uplinker of the Year" program is well received by the satellite community, including customers and competitors of Loral Skynet. If the world community continues its support of similar programs, the industry can extend past competitive barriers and establish an interference free, highly profitable telecommunications community.

The program has proved itself to be effective in its first six years. Figure 2 clearly shows the effect of incentive-type programs such as the "Uplinker of the Year." The number of perfect uplinkers increased from 22 in 1991 to 137 in 1996.

Figure 2



In order to ensure an interference-free environment, satellite providers are obligated to publish access procedures. This ensures all users are familiar with the steps involved in managing error-free accesses.

Access Procedures

When uplinking to Loral Skynet satellites, uplinkers must comply with Loral Skynet's satellite access procedures. Loral Skynet's satellite services personnel will work with all uplinkers to provide procedures and training. The access procedures adopted by the SUIRG are the following:

Before calling for access, check the following:

- Antenna aiming
- Exciter tuned to correct frequency with proper subcarriers
- Polarization optimized and set for the correct polarization
- Transmitter status
- Configuration of Waveguide Switched
- Automatic Transmitter Identification System (ATIS) operation
- Have the order number and other specifics nearby

When calling for access, provide the following information:

- Uplink operator's name
- Uplink name and location
- Satellite, transponder, frequency, bandwidth, uplink polarization
- Start time of feed
- Carrier's order number

Performing the Access

1. During the access process, DO NOT change power, frequency, polarization, or antenna aiming without prior direct instruction from the access control center. If instructed to cease transmission, the uplink operator must comply IMMEDIATELY without discussion.

2. When commanded, provide a lower power, unmodulated carrier at a power of about 5 dB above the transponder's noise floor. Tell the control center you have done this as you throw the switch.

NOTE: If the control center does not see your low power signal they may instruct you to immediately drop. This could indicate you are on the wrong satellite.

3. Wait for further instruction while your crosspol and frequency are checked.

4. When commanded, slowly increase power to operating level and stop.

5. Wait for further instruction while your crosspol is checked again.

6. When commanded, modulate the signal and verify your downlink.

7. Wait for further instruction while your deviation is checked.

8. The control center will ask for, or verify your uplink telephone number. The control center must be able to reach you at this number at any time during the uplink.

9. The control center will verify end time of your uplink and remind you to call the control center with a "goodnight."

Using a process similar to the one above, coupled with the preventive programs discussed earlier, can help the industry as a whole help combat interference problems, and hopefully encourage further training and education programs for all uplinkers. These preventive programs have allowed the industry to use demand programs less frequently.

Demand Programs

While much effort goes into preventing interference, operators must be prepared to take prompt action once interference occurs. With the industry becoming more competitive each day, and huge contracts under negotiation, satellite operators can not wait for users to rectify the situation or future business could be lost. The demand programs address these actions, essentially ceasing an interfering transmission. However, determining the source of an interfering carrier can be formidable. Loral Skynet has three tools available for this: ATIS, Anti-Intrusion Defeator and Locator (AIDAL) and private interference locator services.

Automatic Transmission Identification System (ATIS)

This system is applicable primarily for analog transmissions, inserting the identification of the uplinker into the vertical blanking interval. Typical information includes telephone number, site location, and FCC call letters. This information allows for easy identification of an uplinker.

Anti-Intrusion Defeator and Locator (AIDAL)

The Loral Skynet Telstar 4 satellite has the capability to use receive spot beams to minimize and eliminate interfering uplinks. This helps to reduce the uplink interference and locate the interfering party.

Interference Locator Services.

There are several private service providers that pinpoint the location of an offending transmitter using a triangulation technique coupled with satellite ephemeris data. The interference locator service provides a geographical map that is usually a few square miles in size. This information, coupled with a good earth station database, is usually sufficient to identify an offending site. Assuming the site is staffed, a notifying telephone call may be sufficient for power down of the transmitter.

Summary

With users placing such a high value on satellite communications, it is imperative that the industry takes steps to make satellites interference free. Satellite communication is a valuable transport platform available to all types of companies and educational institutions, but interference can add to company's or educational institution's costs for the service. Satellite service providers, such as Loral Skynet have taken major strides to prevent and control interference, but the industry as a whole must work together to reduce interference problems by educating and training operators. The savings are already becoming clear. As satellites become a global communications transport medium, it is imperative to share interference preventing methods across geographic and competitive lines. The end result will allow all participants the chance to use satellites to their utmost potential and to achieve the maximum value possible from their investment.

The use of satellite communications is expanding globally, and scarce spectrum is a valuable asset. Therefore, the efficient use of the satellite spectrum to provide high quality transmission is extremely desirable. Satellite operators have a responsibility to provide interference free transmissions to their customers. By implementing programs to reduce the amount of harmful interference to their customers, Loral Skynet is showing its willingness to lead the industry in the global interference reduction effort. The *preventive* program, focused on education, cooperation and positive incentives to customers, and the *demand* program, focused on finding and ceasing undesirable satellite transmissions.

The Impact of the Changing Telecommunications Environment on the Submarine Cable Industry Today

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1. ABSTRACT

The decade of the nineties has witnessed a significant change in the telecommunications environment. This change has been characterized by many developments, including regulatory reform and with it a surge of privatizations which have increased the level of telecom infrastructure building and investment activity by both traditional players and a new breed of telecom entrepreneur/investor. Carriers, once wed to building capacity through traditional consortium participation, are now pursuing multiple options to meet the challenging needs of the new telecom environment. Such options include purchasing equity interests in private construction joint ventures, buying other carriers, as well as purchasing capacity from carriers' carriers. Further evidence of a changing environment is manifested by new options available to cable suppliers. Suppliers can either pursue their traditional role of building and supplying cable to owner-carrier specifications or create a new industry based on supplying, owning and managing cable network infrastructure; thus allowing carriers to concentrate on telecom services business. This paper examines these changes and assesses their impact on the ability of the submarine cable industry to accommodate them while still providing global telecom customers with the highest level of reliable, cost-effective and technologically advanced telecom systems.

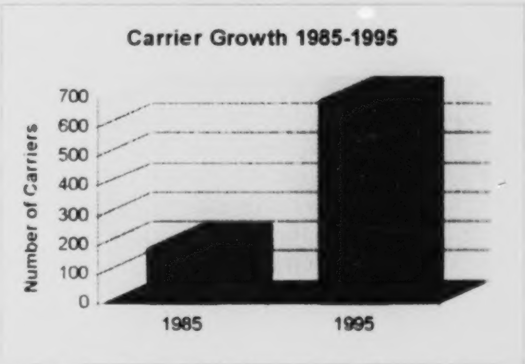
2. A BACKGROUND OF CHANGE

2.1 THE REGULATORY CLIMATE

One of the most conspicuous changes in the global telecommunications environment has been the visible shift in the regulatory climate by state-owned and operated telecom authorities. This has been accompanied by a surge in telecom and other business privatizations that have been and are continuing to attract large-scale investment by entrepreneurs and Multinational Corporations (MNCs) who demand instantaneous and ubiquitous access to communications services.

2.2 MULTIPLE CARRIERS

The need to accommodate increased requirements for voice and non-voice broadband and data services has manifested itself in an almost universal drive for domestic, regional and global connectivity. This, in turn, has, stimulated the creation of a multiplicity of new telecommunications carriers to augment the services heretofore provided by the one or two dominate carriers within a country. For example, as shown in the following figure, over 500[1] new telecom carriers were created in thirteen selected developed and developing countries representing an annual average growth rate of 368 percent.



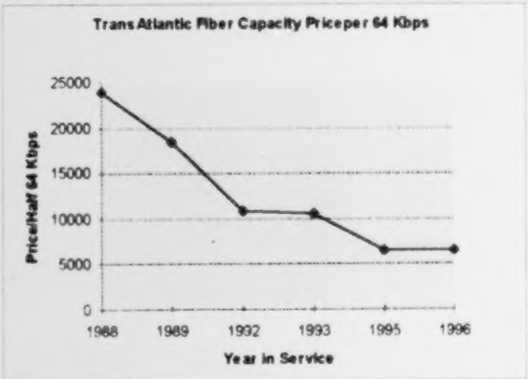
Source: Datapro Information Services & CIT Publications, Ltd.

Figure 1 - Ten Year Carrier Growth

In a further response to the new era of privatization and deregulation, especially that represented by the coming wholesale deregulation of European Union countries in 1998, there has been a corresponding increase in the number of carriers seeking to be licensed in already open markets, such as that in the United Kingdom, where almost 50 new non-facilities based carriers sought and were awarded licenses to operate networks within the country.

2.3 TECHNOLOGICAL CHANGE

Rapid technological changes have characterized the international telecommunications environment during the past few years. The most dramatic change took place in the middle 1980s with the advent of fiber optic cable; eclipsing as it did, coaxial copper cable as the preferred transmission medium. Recent developments in the technology of fiber optics have witnessed the reality of heretofore unheard of transmission rates, such as 20 Gb/s per fiber pair in undersea cable systems being offered today. Higher bit rates permit the transmission of increased call volume between points and with it a significantly lower cost per bit; greatly reducing the per circuit calling costs associated with new cable systems. This phenomenon is illustrated in Figure 2, below:

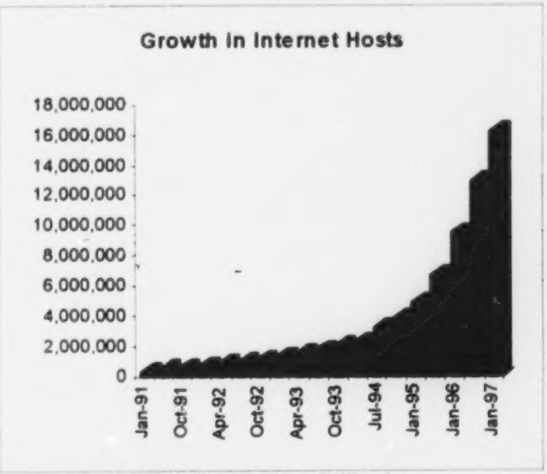


Source: -TSSL

Figure 2 - Declining Cost per Circuit for Undersea Fiber Optic Cable Systems

2.4 SERVICE OFFERING CHANGES

With technological change has come the ability of the industry to supply a new and innovative class of service offerings featuring high-speed packet data services with access speeds in excess of 1.544 Mb/s. These require high transmission performance, large bandwidth, high security and low cost. Coupled to the growing demand for broadband services is the extra demand most likely to be generated by the Internet and multmedia applications. This is giving rise to a new breed of telecom service providers that include Internet Service Providers (ISPs), network backbone providers and routers interconnecting the worldwide Web. Growth in Internet traffic is nothing short of spectacular!. Whatever the measurement, the Internet continues to double in size every year. The following figure illustrates this fact; showing that the number of Internet hosts (any computer linked to the Internet capable of supporting the TCP/IP protocol and possessing a unique global address) has been growing at close to 90 percent annually since 1991[2]. Should this trend continue, by the year 2000 there would be over 100 million hosts worldwide, and perhaps twice that the number of users.



Source: Internet Domain Survey - Network Wizards

Figure 3 - Growth in Internet Hosts

3. TRADITIONAL MODEL OF SUBMARINE CABLE DEVELOPMENT AND OWNERSHIP

The ownership and control of facilities is well illustrated by the problems facing international carriers seeking to own the transmission facilities associated with submarine cable systems, as well as their effort to control the international traffic flowing through them.

The dominant model of submarine cable development and ownership adopted by the major international carriers has been the Traditional

Consortium Model. This model works best in a stable, well defined environment characterized by the unanimity in decision making, financial risk sharing, joint ownership and collective management of the cable system. These factors, for many years, made this model the most common cable planning and ownership vehicle used by the major carriers to build new capacity. This was an easily managed environment featuring predictable manageable growth.

4. CHALLENGES FACING INTERNATIONAL SERVICE PROVIDERS

As the market demands greater capacity and more diverse and complex service offerings, the stable environment of the Traditional Model is threatened by a host of new challenges facing carriers seeking to fulfill their role as international service providers. These challenges, briefly summarized below, include:

- Vigorous new competitors, comprised of facilities and non-facilities based carriers and investor-based entrepreneurs offering new services with new network solutions which are eroding the market shares of traditional service providers.
- Cost pressures arising from heavy investment in facilities (cable systems), as carriers seek to protect their embedded transmission bases.
- The threat to carriers of losing control of their plant, capacity or transmission vehicles to non-carriers as investor-owned cable projects multiply unchecked.
- The rapid growth of broadband services, including Internet and multimedia that are creating temporary capacity shortages due to heavy call volume and longer call duration, thus creating potential revenue loss.

5. CHALLENGES FACING SUBMARINE CABLE SYSTEM SUPPLIERS

The changing telecom environment has also created challenges for submarine cable system suppliers in today's highly competitive marketplace. These challenges include:

- Compression of manufacturing leadtime to accommodate the shortened delivery requirements for providing installed cable capacity.
- The need to provide a greater proportion of customer education and training time to new customer entrants into the marketplace.
- Maintaining amicable relationships with traditional carrier customers in the face of a new industry dynamic - the infusion of capital into telecom infrastructure by profit driven entrepreneurs hoping to seize major telecom traffic revenues for themselves.
- An opportunity to expand their traditional roles as suppliers to the industry by fulfilling a market need for ownership, management, marketing and financing of submarine cable infrastructure.

6. THE CHANGING ROLE OF INDUSTRY PARTICIPANTS

As previously observed , market demand for new and highly competitive service offerings, together with the entry of a new class of industry participant - the entrepreneur investor - has produced multiple challenges for both carriers and suppliers, and with them a significant opportunity to change and/or expand their respective future roles.

Suppliers may choose to augment their traditional role as systems suppliers/integrators and assume additional responsibilities as owner/operators, or as commercial venture partners, offering sales agency and management services to their owner/investor customers.

Carriers, on the other hand, could react to new challenges in one of two ways. First, by creating incentives for entrepreneur investors to share in building cable infrastructure in commercially viable and mutually profitable undertakings, or, second, by mounting substantial resistance to drive entrepreneur investors out of the marketplace.

7. ALTERNATIVE MODELS FOR CONSIDERATION BY THE INDUSTRY

The extent to which carriers and suppliers decide to pursue alternative commercial ownership/supplier options is illustrated in the following industry models[1]

1. Traditional Consortiums - The classic ownership model described in Section 3, above. It is based on collective ownership, management

and utilization of cable systems, such as TAT12/13.

2. Carrier Cable with Return on Investment Option - Similar to consortium model, but offers carriers the option of earning a return on invested capital, as opposed to solely owning a depreciable asset. Example: SEA-ME-WE3.

3. Carrier Cable with Equity Investors- Offers a commercial equity investment opportunity to private investors and permits carriers to purchase capacity upon demand. Example: Guam-Philippines.

4. Supplier Cable with Investor(s) - Broadens supplier role by offering commercial sales/ownership/management opportunity to traditional cable suppliers. Example AC-1

5. Carrier Cable with ROI motive - Investment by carrier in international infrastructure for the purpose of attracting and selling capacity to others. Example:Gemini.
6. Investment Joint Venture - Joint ownership of an equity position in an equity-based venture as opposed to asset ownership/management. Example: FLAG.

8. THE WIN-WIN SCENARIO

The alternative ownership models described above could potentially lead to fruitless competition between supplier sponsored and carrier/consortium cable initiatives. This portends competitive turmoil and introduces disorder into what is presently a relatively structured and stable industry. Thus, it is imperative that both carriers and suppliers create a "win-win" scenario going forward which redounds to the benefit of all. Based on constructive dialog and continuing communication between the parties, a "win-win" scenario ensure efficiencies in capacity planning, network design and utilization that would result in lower capacity costs, improved service capability and greater responsiveness to end-user needs.

9. END-USER EXPECTATIONS OF THE INDUSTRY

End-users expect instantaneous, ubiquitous and bandwidth intensive services at ever decreasing prices. This will tax the ability of the industry to respond in the rapidly changing telecom environment described in the foregoing paragraphs. Unless, an accommodation is reached between traditional carriers and suppliers regarding their changing roles and responsibilities relative to ownership and supply, the consequences are dire indeed!

Nevertheless, there are solid grounds for optimism, as carriers and suppliers have recognized the advantages and benefits of constructive dialog that mitigates pernicious competition and serves the best interests of all, carrier, supplier and customer alike.

10. REFERENCES

[1] I.T.U. 1996 World Telecommunication Devleopment Report. International Telecommunication Union, CH-1211, Geneva, Switzerland.

[2] TeleGeography. 1995. Global Telecommunications Traffic Statistics & Commentary. TeleGeography, Inc. , Washington, D. C.

[3] TN33 Internationale Kabelsysteme. 1997. Future Activities in International Cable Networks. Deutsche Telekom, Frankfurt, Germany.

Long-Term Corrosion Behavior of Engineering Materials in Marine Atmospheric Environments

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Abstract

Predicting long-term service performance on the basis of short-term accelerated corrosion tests is a highly desirable objective. However, despite their popularity, accelerated salt-spray tests performed in cabinets often exhibit poor correlation with service experience. Fortunately, long-term (e.g. 20 - 50+ years) corrosion data have been developed in actual aggressive marine environments over the past several decades; such data can be used for cost-effective materials selection to improve reliability, longevity, and availability of outside telecommunication plant hardware in harsh marine atmospheres.

Introduction

Corrosion of engineering materials is a formidable, multifaceted, and economic problem. Degradation of materials in the service environments can result in structural failure or loss of function. This leads to unscheduled downtime, requiring maintenance, repair, or replacement, with attendant consequences pertaining to loss of revenue, compromise of personnel safety, pollution of the environment, etc. Marine environments in coastal applications on large landmasses, or on entire islands, represent among the most severe and challenging conditions from a corrosion-control standpoint.

Corrosion engineering is a multi-disciplinary but fledgling field where long-term performance of materials cannot often be predicted reliably without the benefit of long-term test data and/or service experience. A number of "accelerated" tests have been devised or proposed over the years in order to reduce the test duration. Perhaps the most common, misused, and misleading test is the ASTM B117 salt-spray method(1) -- even for marine environments. However, to date no reliable method has been found as a universally applicable substitute for duplicating outdoor service performance of materials. In addition to providing realism, long-term testing in representative service environments is essential for developing baseline data to serve as benchmark for checking the "correlation" of existing or new accelerated tests.

Marine environments are complex but typically they are classified into the following zones :

Atmospheric -- airborne salt and usually high relative humidity conditions
Splash and Spray -- most corrosive zone; due to thin layer of oxygen-saturated salt-water film, and wind and wave action
Tidal -- alternate immersion due to changing tide levels; also this zone is usually most prone to macrobiofouling
Immersion -- seawater containing a variety of ions, dissolved oxygen, and live macro- and micro-organisms (bacteria)
Mud -- anaerobic, salt and bacteria-containing sediments; soil in coastal areas can be regarded as somewhat analogous to the mud zone.

The scope of this paper is limited to only corrosion issues of materials exposed in the marine atmospheric zone.

The supposedly "overtest" conditions of salt-spray tests do not adequately duplicate marine atmospheric conditions, which are highly influenced by factors such as wind speed, direction, time-of-wetness, dewpoint, temperature, washing effects of rainfall, salt deposit buildup in sheltered areas, etc. Furthermore, emissions from chemical, power, and manufacturing plants and automobiles in the vicinity can exacerbate marine corrosion problems; i.e. modify conditions that are often either not considered or adequately replicated in traditional salt-spray tests.

Experience has shown that the most reliable performance data are usually only obtained from long-term exposure of materials in natural marine environments. Such data have been generated since circa 1935 at LaQue Corrosion Services' world-renowned test facility in Kure Beach, NC; and also at Wrightsville Beach, NC, since circa 1950.
This paper provides an overview of the long-term corrosion behavior of engineering materials such as carbon steels, galvanized steels, stainless steels, aluminum alloys, copper alloys, nickel alloys and titanium in marine atmospheres. Such data are invaluable to designers for materials selection for coastal and offshore applications in a wide variety of industries such as telecommunications, cable, power, chemical, construction, shipping, oil/gas, etc., where plant equipment is exposed to corrosive marine environments.

Basic Corrosion Mechanisms

For metals and alloys, corrosion in marine environments is electrochemical in nature. The mixed potential theory postulates that corrosion is associated with DC current flow due to potential differences between anodic and cathodic areas, either on the same or dissimilar materials, in the presence of an electrolyte. In marine atmospheres, a thin moisture film containing dissolved salt and capable of supporting high rates of oxygen transport (from the atmosphere, through the film, to the metal surface) represents a highly corrosive electrolyte toward susceptible materials such as bare carbon steel. The chloride ion derived from sodium chloride (salt) becomes highly aggressive (oxidizing) in the presence of dissolved oxygen. Potential differences between anodic and cathodic areas on the same piece of metal result from composition and metallurgical differences between local areas and/or concentration differences in the electrolyte.

For carbon steels, the corrosion mechanism can be represented as follows :

Anodic half-reaction : Loss of electrons (e) results in the oxidation of iron (Fe) in the metallic state to ferrous ion (Fe^{2+}) in the ionic state.

$$Fe - 2e \rightarrow Fe^{2+}$$

Cathodic half-reaction : In order to maintain charge neutrality, the "surplus" of electrons resulting from the anodic half-reaction above have to be consumed by some cathodic half-reaction(s). In unpolluted marine atmospheres, the principal cathodic half-reaction is oxygen reduction

$$^1/_2\ O_2 + H_2O + 2e \rightarrow 2OH^-$$

The by-products of the anodic and cathodic half-reactions (ferrous and hydroxyl ions, respectively) react with each other to generate insoluble ferrous hydroxide corrosion products. In the presence of oxygen, ferrous hydroxide is further oxidized to ferric hydroxide -- the familiar "red" rust corrosion product

$$Fe^{2+} + 2OH^- \rightarrow Fe(OH)_2 + O_2 \rightarrow Fe(OH)_3$$

If the corrosion product film is adherent and dense, it can serve as a protective barrier and slow down subsequent attack on the base metal.
Materials such as copper-base alloys and weathering steels rely on the formation of adherent protective corrosion product films (patina) for long-term protection. Weathering steels contain small additions of copper (~ 0.2 weight %) and phosphorous (~ 0.15 %) which allow protective corrosion product films to form under specific conditions -- i.e., frequent washing of the surface salt deposits and drying by the sun. On ordinary carbon steels, the rust films are not protective in aggressive marine atmospheres; in fact, the corrosion products spall off by exfoliation and corrosion of the substrate continues at high rates.

In polluted marine atmospheres, species such as sulfuric acid (derived from sulfur dioxide) can significantly increase corrosivity of the salt-containing moisture film by (a) facilitating additional cathodic half-reactions such as hydrogen evolution : $2H^+ + 2e \rightarrow H_2$, and (b) by dissolving existing corrosion product films and/or preventing formation of protective ones. Materials such as steel, zinc and cadmium are particularly susceptible to accelerated attack in polluted marine atmospheres.

Stainless steels are iron-base alloys that contain > 10.5 % chromium (Cr). The Cr aids in the formation of a thin, air-formed, mixed chromium-oxide/iron-oxide "passive" film on the metal surface. Chloride ions are potentially corrosive toward such films while oxygen is essential for repassivation. Whether attack occurs, and its extent, is highly influenced by factors such as alloy composition, chloride concentration, crevice geometry, surface finish, etc. Thus all "stainless" steels are not stainless !

Aluminum-base, nickel-base, and titanium alloys also rely on the formation of thin, passive, oxide films for corrosion protection.

Types of Corrosion

Degradation of material properties due to corrosion can manifest in various forms. For instance, attack which occurs fairly uniformly is known as general corrosion. Predictions of service life are relatively easier to estimate with this form of corrosion if general thinning rates are known. Carbon steels have very high rates of general attack in severe marine environments while passive stainless steels, aluminum alloys, nickel alloys, and titanium have very low general corrosion rates.

If there is a potential difference between two dissimilar metallic materials and they are in electrical contact with each other, a DC current can flow between them in the presence of an electrolyte. Depending on various factors, attack on one metal may be accelerated due to electrical contact with the other. This is commonly referred to as galvanic, dissimilar or bimetallic corrosion. The more electronegative metal in the galvanic couple serves as the anode, where corrosion is accelerated; while the more electropositive metal is the cathode whose corrosion slows down or stops. The extent/rate of attack is directly related to current density at the anode. Under full immersion conditions, large cathode-to-anode surface area ratios result in high rates of attack on the anodic material; conversely, small cathode-to-anode area ratios are more desirable. Simple galvanic series or charts have been devised to provide guidelines for reducing galvanic corrosion problems(2). In the hands of inexperienced users , these guidelines are often misunderstood and misapplied. For example, it is erroneously assumed that the bigger the potential difference between two dissimilar materials, the more severe the galvanic corrosion. In fact, polarization effects influence kinetics more than potential difference (Ohm's Law). Thus, for example, stainless steel fasteners in aluminum (relatively larger potential difference) are more compatible than, say, carbon steel fasteners in copper (relatively smaller potential difference). Furthermore, in marine atmospheres, the anode-cathode ratio is usually irrelevant because the galvanic corrosion interaction distance between the anode and cathode is limited to ~ $^1/_4$" (~ 6 mm) due to ohmic resistance of the thin film electrolyte (3).

Localized corrosion in the form of pitting or crevice attack can produce rapid throughwall penetration. Conditions can develop on passive alloys that allow corrosion attack to initiate and propagate locally due to breakdown of the oxide film and inability to repassivate. Surface deposits, embedded particles, corrosion products, tight crevices, laps, heavy weld scale, etc., allow chloride ions to concentrate and initiate attack while preventing access of sufficient oxygen to restore passivity. Marginal stainless steels and certain aluminum alloys, for example, are particularly susceptible to localized attack in marine atmospheres. Again, because of thin film electrolytes associated with atmospheric conditions, localized attack tends to be less compared to full immersion conditions.

Dealloying is the selective corrosion of one metal or phase from an alloy, resulting in a weakened structure. Dezincification, the preferential loss of zinc from brasses (copper-zinc alloys) is the most commonly observed form of dealloying.

Preferential corrosion attack along grain boundaries in a metallic material is known as intergranular corrosion (IGC) or intergranular attack (IGA). Certain stainless steels are susceptible to IGC, due to depletion of chromium in heat-affected-zone areas, e.g. as a result of welding or improper heat treatment. However, there is generally much less concern with this problem under atmospheric conditions, compared to full immersion. Certain aluminum alloys are also prone to IGC in marine atmospheric environments; because the voluminous aluminum corrosion products tend to produce expansive forces that pry the structure apart, this form of attack is also known as exfoliation.

Stress corrosion cracking (SCC) of susceptible materials occurs due the conjoint action of tensile (residual and/or service) stresses and specific corrodents. Alloys known to be susceptible to SCC in marine atmospheres include high strength steels, high strength aluminum alloys, and certain stainless steels. Attack can be either intergranular (along grain boundaries) or transgranular (through grains). Hydrogen embrittlement is a form of cracking that results from generation of atomic hydrogen, e.g. during electroplating, or in service, e.g. due to galvanic contact with a more electronegative material. Corrosion fatigue is somewhat akin to SCC except that failures occur under cyclic loads in the presence of corrosive species.

Erosion-corrosion refers to attack under flow conditions; this is not applicable to most marine atmospheres. However, erosion associated with airborne sand may be of concern in specific coastal areas. Also, fretting corrosion may be an issue where there is minute relative movement between faying surfaces -- movement that allows removal of protective films and subsequent corrosion of the exposed surfaces and debris particles.

Stray-current corrosion results where DC current, straying from its intended path, discharges from a metal surface into an electrolyte. Breaks in coatings tend to increase current density and hence exacerbate attack at exposed areas. This is less likely to be a problem in marine atmospheres, due to limiting ohmic resistance of the thin film moisture (electrolyte) path -- compared to full immersion or buried conditions.

Long-Term Corrosion Data

General corrosion is typically reported as metal thickness loss, e.g. mils per year (mpy, 1 mil = 0.001"), or µm/yr or mm/yr. 1 mil = 25 µm; 1 mm ≈ 40 mils.

Carbon Steel -- General corrosion rates can vary widely depending on location, degree of sheltering, rain washing, etc. Typical examples of rates in marine atmospheres reported in the literature(4) are summarized below.

Location	Corrosion Rate (µm/yr)	(mpy)
Kure Beach, NC (250-m lot)	147	5.8
Daytona Beach, FL	295	11.6
Cape Canaveral, FL (180-m lot)	442	17.4
Point Reyes, CA	500	19.7
Kure Beach, NC (25-m lot)	533	21.0
Galeta Point Beach (Panama Canal Zone)	686	27.0
Cape Canaveral, FL (beach)	1070	42.0

It is apparent that bare carbon steel can incur general corrosion rates on the order of 20 to 40 mpy (~ 0.5 to ~1 mm/yr) in severe marine environments. At these rates, a 1/4" (~ 6mm) section can lose 50% of its thickness in ~1.5 to ~ 3 years if corrosion occurs from both sides; or ~ 3 to ~ 6years if only one side is exposed. Under the right conditions, weathering steels may give corrosion rates ~ 50 % to an order of magnitude lower. However, very close to the ocean, constant wetting by salt spray and little opportunity to dry, will sustain high rates of corrosion like with plain carbon steels.

Galvanized Steel -- Galvanized refers to a zinc coating usually applied by hot dipping finished parts in a molten zinc bath, or by electroplating. Zinc functions as a barrier to the environment and galvanically (electrochemically) protects small areas of exposed steel by sacrificial action. The life of the zinc coating depends largely on thickness. 1 oz/ft^2 of zinc on a steel surface ≈ 300g/m^2 ≈ 1.7 mils ≈ 43 µm(5). Care should be exercised in converting weight of zinc coating to thickness values for flat products that have been galvanized on both sides, such as sheet. Weight in those cases refers to total mass of zinc per unit area but counting both sides. Thus, the thickness of zinc on one side of a sheet that has been galvanized on both sides and has a total zinc weight of, say, 1 oz/ft^2 (300g/m^2) will be only half the value cited above, i.e., 0.85 mils or 21.5 µm, per side. Thickness of zinc on hot-dip galvanized hardware ranges typically from ~ 1 to 3 mils (25 - 75µm).

Lowe(6) evaluated the performance of galvanized pole line hardware on the windward shore of Oahu, Hawaii. The marine atmosphere in this area is reportedly very severe because strong trade winds blow from the ocean, with waves breaking constantly over shallow coral-covered reefs. The original thickness of galvanizing on carbon steel parts ranged from 1.9 to 3.9 mils (~ 48 - 99 µm) -- average 2.7 mils (68µm); and on low-alloy steel from 4.7 to 8.9 mils (~ 118 - 226µm) -- average 6.4 mils (162 µm). Reportedly, no zinc was left on any of the parts after 3 years and the steel was beginning to pit. Furthermore, threaded ware was badly seized due to corrosion. This clearly demonstrates the limitations of zinc coatings in severe marine atmospheres. The thickness of zinc cannot be increased indefinitely on new hardware. Tolerances on faying surfaces such as threads, for example, limit the amount of zinc coating. Besides, coating thickness at corners and in crevices tends to be even lower. Coating damage can occur during installation and in service. Furthermore, galvanic protection is afforded only to relatively small areas of exposed substrate.

Stainless Steels (SS) -- There are several hundred types or grades of stainless steel covering a wide range of compositions and properties, including corrosion resistance. They are generally classified into the following five broad categories on the basis of their metallurgical structures.

Ferritic (e.g. Types 409, 430, 446, 29-4C)
Martensitic (e.g. Types 410, 420, 440C)
Austenitic (e.g. Types 302, 303, 304, 304L
316, 316L, 317L, 904L, AL6XN)
Duplex (e.g. Types 329, 2205, 255, 2705)

Precipitation Hardening (e.g. 17-4 PH, 17-7 PH, A286)

Typical compositions are shown below.

		weight %				
Type	UNS No.	Cr	Ni	Mo	C	others
409	S40900	11	-	-	0.08	Mn,Si
420	S42000	12	-	-	0.15	Mn,Si
304	S30400	18	8	-	0.08	Mn,Si
316	S31600	16	10	2	0.08	Mn,Si
316L	S31603	16	10	2	0.03	Mn,Si
2205	S31803	21	4.5	2.5	0.03	N,Mn,Si
17-4PH	S17400	15.5	3	-	0.07	Al,Cu,Mn,Si

Note : Cr, Ni, Mo min., C max., Balance Fe

Stainless steels remain "stainless" so long as the passive film on the surface, if damaged locally, can reheal spontaneously. Otherwise, pitting, crevice corrosion, or stress corrosion cracking (SCC) may occur on susceptible grades. Embedded iron from fabrication/handling, scratches, weld scales, improper heat treatment, and deposits can all impair localized corrosion resistance. Smooth, clean surfaces are more resistant than ground, dirty, contaminated ones. Surface treatments such as pickling, "passivation", and electropolishing enhance corrosion resistance.

Type 316 stainless steel (SS) is usually considered the "minimum" grade for aggressive marine atmospheres. Based on 15-year mass loss data for specimens exposed 250 meters from the ocean at Kure Beach, NC, the general corrosion rate of Type 316 SS was calculated to be < 0.03 µm/yr (< 0.001 mpy)(7) -- compare this to a corrosion rate of 147 µm/yr (5.8 mpy) for carbon steel at the same location. In other words, the general corrosion rate of 316 SS is about 5000 times less than carbon steel at this harsh location.

Twenty-six year results at Kure Beach, NC, show that for 316 SS, pit depths were 60 and 40 µm at 25 and 250 meters from the ocean , respectively(8). Crevice corrosion depths at spot welded joints were 140 and 50 µm, respectively. While the specimens exhibited rust staining, there was no significant loss in mechanical properties such as yield and tensile strengths, or change in ductility (% elongation). Moreover, the rust stains were amenable to removal by brushing with mild scouring powder. Test results have shown that, other than in the furnace sensitized condition (i.e. improper heat treatment) stainless steels such as Type 316 are highly resistant to SCC in marine atmospheres(9).

Aluminum Alloys -- Corrosion resistance of Al alloys depends on composition, heat treatment (temper), and % cold work. Al alloys containing high levels of copper (for strength), such as 2000 and 7000 series, generally have poor corrosion resistance in marine service. General corrosion rates of "marine" alloys such as 1000, 3000, 5000, and 6000 series are very low, typically < 0.01 µm/yr (< 0.25 mpy)(10). Even localized corrosion resistance can be acceptable in marine atmospheres, depending on specific alloy; for example, maximum pit depths ranged from ~75 to ~175µm (~ 3 - 7 mils) after 7 years exposure at Kure Beach, NC, for a range of Al alloys(11).

Since Al has an active corrosion potential relative to many other materials, e.g. copper alloys, steel, nickel alloys, graphite, it can incur galvanic corrosion readily when it is in contact with more noble materials. Resistance to SCC and exfoliation is influenced by alloy composition and heat treatment. The high strength 2000 and 7000 seies are generally most susceptible.

Copper Alloys -- General corrosion rates of copper alloys also tend to be very low in marine atmospheres, typically < 0.2 - 5 µm/yr (~ 0.01 - 0.2 mpy)(12) due to the formation of protective patina. Localized corrosion resistance is generally even better. Despite these attributes, runoff of copper corrosion products on to more active materials, e.g. Al, Zn, steel should be avoided as it can lead to galvanic corrosion. In marine atmospheres certain brasses (copper-zinc) alloys are susceptible to dezincification and SCC.

Nickel Alloys -- General corrosion rates of a wide range of nickel alloys exposed at Kure Beach, NC, for periods up to 49 years have been found to be < 1 µm/yr (< 0.04 mpy)(13). Pitting and SCC resistance have also been observed to be excellent. Alloys such as MONEL® 400 (nominally 70Ni- 30Cu) develop a beige/green patina but exhibit very good resistance to galling, while alloys such as HASTELLOY® C (nominally 67Ni-15Cr-15Mo-3Fe) have remained highly reflective, even after 55+ years' exposure at Kure Beach.

Titanium Alloys -- These alloys are extremely resistant to general and localized corrosion in marine atmospheres. General corrosion rates are typically < 1µm/yr (< 0.04 mpy)(14). They also exhibit very high resistance to SCC.

Summary

Long-Term corrosion data are available which allow cost effective selection of materials where long service lives are desired in harsh marine atmospheres. These data are invaluable to designers since accelerated corrosion tests do not usually give reliable service-life predictions.

For outdoor telecommunication plant in severe marine environments, the benefits of selecting more corrosion-resistant alloys, such as the right grades of stainless steel, are apparent from long-term corrosion test data.

References

ASTM B117 - Practice for Operating Salt Fog (Spray) Cabinet. American Society for Testing and Materials, West Conshocken, PA, 1996.

ASM Handbook, 9th edition, Vol. 13, Corrosion, ASM International, Materials Park, OH, 1987, p235.

Atmospheric Galvanic Corrosion, by V. Kucera and E. Mattsson, in Atmospheric Corrosion, edited by W. H. Ailor, J. Wiley, 1982, p567.

K. Coburn, et. al. "Corrosiveness of Various Atmospheric Sites as Measured by Specimens of Steel and Zinc", ASTM STP 435, American Society for Testing and Materials, West Conshocken, PA, 1968, p360.

ASM Handbook, 9th edition, Vol. 1, Corrosion, ASM International, Materials Park, OH, 1978, p753.

A. Lowe, Corrosion, Vol.17, NACE International, Houston, TX, 1961, p177t.

Corrosion Resistance of the Austenitic Chromium-Nickel Stainless Steels in Atmospheric Environments, The International Company, 1970.

A. Baker and T. S. Lee, "Long-Term Corrosion Behavior of Various Grades of Stainless Steel", ASTM STP 965, American Society for Testing and Materials, West Conshocken, PA, 1988, p52.

L. Money and W. W. Kirk, Materials Performance, Vol. 17, July 1978, NACE International, Houston, TX, p28.

H. Ailor, British Corrosion Journal, Vol. 18, The Institute of Metals, 1966, p237.

H. Ailor, Metal Exposures at Tropical and Marine Sites, 6th Offshore Technology Conferenece 1974, Vol. 1, p293.
W. Hummer, C. R. Southwell, and A. L. Alexander, Materials Performance, Vol. 7, Jan. 1968, NACE International, Houston, TX, p41.

A. Baker "Long-Term Corrosion Behavior of Materials in the Marine Atmosphere", ASTM STP 965, American Society for Testing and Materials, West Conshocken, PA, 1988, p125.

B. Bomberger, J. Electrochem. Soc., Vol. 101, Sept. 1954, p442.

New Undersea Cable Developments and Satellite Services: Toward Complementary Coexistence in the 21st Century

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1. ABSTRACT

A new generation of technologically advanced undersea cable systems that provide dramatic increases in capacity, with concomitant decreases in per-circuit costs is now being deployed . At the same time, a new generation of global satellite systems is looming over the horizon, promising to provide a diverse array of ubiquitous services to end users. The dramatic changes in undersea cable and satellite technologies have been accompanied by equally dramatic changes in our notions regarding the coexistence of what once were viewed as competing technologies. In the past, coexistence was characterized by uneasy and internecine competition for routes and revenues. In this paper, we will discuss the new reality, in which coexistence of satellite and undersea cable systems is based on making best use of the unique, complementary capabilities of each technology in a diverse and rapidly-growing market. We will discuss the need to establish a framework for interworking, in order that we may most efficiently develop the Global Information Infrastructure (GII), in an environment of mutual cooperation and collaboration.[1]

2. THE PAST

During the decades of the nineteen sixties, seventies and into the eighties, satellite communications systems were the predominant carriers of transoceanic telecommunications traffic. In 1986, 78 percent of transatlantic and 95 percent of transpacific traffic was via fixed geostationary satellite systems, the remainder being carried on analog undersea copper coaxial cable. [2]

In general the satellite systems were administered by intergovernmental state-owned organizations such as INTELSAT, which launched its first satellite in 1965 and currently has over twenty satellites in geostationary orbit. Undersea cables, on the other hand, were implemented by consortia of telecommunications carriers, who owned and operated them to carry their own transoceanic traffic.

In the late 1980s, the first private satellite systems, PanAmSat and Astra were launched; followed shortly by others such as AsiaSat. These providers derived their revenues principally from leasing capacity on a long-term basis to television broadcasters, telephone operators and to companies establishing private voice and data networks.

At the same time, digital fiber optic cable systems were introduced into the international telecom marketplace and began to seriously compete with satellite providers for major intercontinental telecom traffic routes. The first transoceanic fiber cables, TAT8 in the Atlantic and TPC3 in the Pacific, were installed in 1988 and 1989 respectively. The high quality and relatively low per-circuit cost of these began a revolution in international telecommunications.

Paced by advances in technology and increased competition among suppliers, rapid progress was made by the fiber optic submarine cable industry in the capacity attainable on a single fiber. Between 1988 and 1996, the capacity available from a single fiber on a transoceanic system increased by a factor of 16, with a proportional decrease in the cost per circuit.

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These developments reversed the trend observed in the early 1980s, in which predominant transatlantic and transpacific capacity providers were satellite networks. In fact, by 1996, 64 percent of transatlantic and 79 percent of transpacific traffic was via fiber optic undersea cable. It appeared that satellite networks no longer posed a serious competitive threat to the growth and viability of transoceanic undersea cable systems.

3. THE PRESENT

Today, the forces of privatization and deregulation have been driving an explosive development of telecommunication infrastructure worldwide. This has led to the creation, through both government and private sector investment, of a vibrant global information marketplace, that is boosting economic growth, job creation, encouraging broad-based economic, social and political dialogue within and among the nations of the world and, perhaps most importantly, providing universal service to a great mass of underserved citizens of the world. This is the "Global Information Infrastructure" (GII), created by an information explosion that is generating rapidly growing demands on all types of communications systems: terrestrial wired and wireless, undersea, and satellite.

In the late 1990's, fiber cables have attained such high capacity that it is no longer practical to even back them up with satellite systems - there simply isn't enough spectral bandwidth available to restore traffic in the event of a cable break. As a result, new transoceanic optical networks such as TAT 12/13 and TPC5 are connected as self-healing rings. These noteworthy technical advances have been accompanied by equally dramatic reductions in circuit costs. Yet, in certain regions, such as the Asia-Pacific, capacity is quickly being oversubscribed by Internet traffic, forcing operators to produce temporary work-arounds to accommodate their end-user customers. Clearly the service demand driven by the GII is quickly outstripping the ability of suppliers to provide it.

The development of optical wavelength division multiplexing technologies and more sophisticated optical networking techniques have allowed the development of very large optical networks connecting many countries simultaneously with ultra-high-capacity fiber cable, allowing cable networks to attain some of the multipoint character once associated only with satellite networks.

Although satellites are carrying a decreasing marginal share of telecom traffic, all carriers having access to both satellite and fiber optic cable technologies utilize both, recognizing the complementary nature of the two media. Though the number of long routes competitively served by satellite services is declining , satellites are still the predominant means of serving remote or rural locations.

As a result of the changing competitive environment, and technological developments in satellite and mobile communications technologies, there has been a recent evolution toward large scale private rather than governmental involvement in satellite systems. These private systems are not aiming at head-to-head competition with cable networks, but rather seek to exploit the ubiquity and flexibility that only satellite-based networks can offer.

There has been significant growth in the diversity of satellite services offered ranging from VSAT services, to direct broadcast satellite and direct-to-home services, paging, messaging, and point of sale networks; as well as a plethora of new mobile satellite services.

This trend has also manifested itself in the proliferation of proposals for a new generation of Global Mobile Personal Communications by Satellite Systems (GMPCS) - also known as Satellite PCS (S-PCS), as well as commercial Ka-

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band broadband satellite networks to be deployed in the near future (1998 to 2002).

The level of proposed investment in satellite systems is extraordinary, and numerous companies, and consortia of companies, are participating in the development and marketing of these services . There are now more than double the number of satellite operators in the 1980's.

At the sane time, the phenomenal growth of international traffic generated by the internet and new multimedia services has drawn private investors into the undersea cable arena as well, and some of the largest new cable projects are being mounted by entrepreneurs, rather than carriers.

4. THE FUTURE

As we enter the dawn of the 21st century the picture becomes more complicated yet.

The future telecommunications environment will witness the entrance of new participants into the market, including major new and privately financed satellite system providers, new facilities based carriers, carrier's carriers, resellers, investor/entrepreneurs, CLECs as well as Internet Service Providers (ISPs). They will all be handling enormous quantities of telecom traffic, both voice and data which, as previously stated, will be driven by the explosion in broadband, multimedia and Internet applications.

At the same time, the globalization of commerce is creating a relentless drive by all segments of the market to increase domestic teledensity and regional/global connectivity, with ever increasing needs for bandwidth to accommodate the explosion in multimedia and Internet applications. This has created new and pressing capacity needs in all regions of the globe, which are just now being fully recognized and appreciated.

Thus, the message for both fiber optic cable suppliers and satellite service providers is that there is an almost insatiable demand for bandwidth to be supplied and that the days of pernicious head to head competition are past. The overriding issue is one of maximizing efficient interworking of satellite/cable networking on a global scale: enhancing service where it already exists, filling in the gaps where service does not exist, and providing for the efficient transport of large volume traffic from all media on a truly global scale.

Both fiber optic cable suppliers and satellite service providers have begun planning the introduction of a range of new cable systems and satellite services primarily designed to satisfy the expanding market for broadband services worldwide. Thus, establishing the relationship between fiber optic cable systems and satellite services will be crucial in the first decade of the next century.

The impact of this colossal growth on undersea cable systems will be dramatic. Cable networks using new dense wavelength division multiplexing (DWDM) technologies will increase individual fiber pair capacity to unprecedented levels, e.g., in excess of 100 Gb/s per fiber pair, and more sophisticated optical networking techniques will make ultra-high -capacity, low-cost transport networks available throughout the world. One proposed cable project would create *in itself* a complete global network.

Likewise, the satellite industry will bring to bear a number of new approaches to extend the range and sophistication of services offered through a new generation of satellite systems. Many of these systems will utilize satellites placed in low, nonstationary earth orbits at (LEOs) and in higher-altitude nonstationary medium earth orbits (MEOs). These systems incorporate constellations of satellites ranging roughly from fifty to over 250, interconnected through intersatellite links (ISLs). The new LEO and MEO systems are designed to handle a variety of

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applications offering everything from narrowband paging to high speed data and compressed video up to 2 Mb/s. Other new systems will use constellations of Geostationary satellites either alone or in combination with LEO or MEO networks, to further expand the range of options available.

Although the GII has stimulated as well as responded to global demand for telecom services, as much as 50 percent of the world's population has not made a phone call due to lack of infrastructure. Here the new generation of satellite systems can play a vital role in providing wide market entry which will combine "fill-in-the-gaps" wireless voice telephony with fax, paging, both high and low-speed data and other services. They will bring service to areas with little or no existing wireline infra-structure, and in most cases are complementing rather than competing with existing terrestrial wireless/PSTN services.

Thus, the satellite industry will provide for delivery of a multitude of end-user services ranging from broadcast to broadband, at the same time the cable industry will provide ubiquitous ultra-high-capacity international connectivity.

5. CALL TO ACTION

With the proliferation of new services and systems, it is not surprising that some confusion exists regarding the proper roles of satellite and fiber optic cable systems in addressing the future market for these services. Many, particularly those outside the telecommunications industry, still hold to an antiquated notion of competition between the technologies, or an either-or choice. The reality is the need to make best use of all technologies on a global basis, using the best attributes of each to create the most effective global infrastructure. We must jointly establish mechanisms and protocols for interworking all technologies, including satellite and fiber optic cable, to meet growing needs for telecommunication services worldwide.

6. CONCLUSIONS

The relationship between undersea cable suppliers and satellite network providers was once characterized by rivalry for routes and revenue. Today, however, it appears to be one founded less on upon strident competition and more on mutual cooperation and integration of network capabilities. This is the result of forces leading to the creation of the Global Information Infrastructure (GII). And it is through such cooperation and network integration that the long term health of the GII will be assured.

7. REFERENCES

[1] Organisation for Economic Co-Operation and Development. 1988. Satellites and Fiber Optics - Competition and Complementarity. The OECD Catalogue of Publications, Paris.

[2] TeleGeography. 1996. Global Telecommunications Traffic Statistics & Commentary. TeleGeography, Inc., Washington, D.C.

Multi-Sensor Instrumentation on a Focus 1500 Search and Survey System

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SAIC
USA

ABSTRACT

A FOCUS-1500 ROTV has been fully instrumented for deep water search and survey applications using acoustic, optical and magnetic sensors for operations to 1500 meter water depth. The recent deployments of the system mark a number of firsts for deep water applications, including Deepest operation of the FOCUS vehicle; deepest operation of a Laser Line Scan System; deepest operation of a high resolution Multibeam system; deepest operation of simultaneous surveying and mapping of an acoustic/optical/magnetic suite of sensors. The system has recently operated off the East Coast of the United States and the south coast of the Island of Hawaii. Additional deep water surveys will be completed by the end of 1997. The system was designed for the following applications: Pipelines inspection; telecommunications cable inspection; route surveys; environmental surveys; search operations and related studies. Data from all surveys is presented below, including a route survey and site investigation of the Loihi Seamount, located south of the Island of Hawaii.

INTRODUCTION

A MacArtney A/S FOCUS 1500 remotely operated tow vehicle (ROTV) has been fully instrumented by Science Applications International Corporation (SAIC) to conduct intermediate-to-deep water survey and search operations. The fully integrated system supports multiple sensors, including high resolution acoustic systems, imaging sensors and magnetic sensing devices. The integrated systems are discussed herein, operational considerations are provided, data processing techniques are presented and example records are provided for review. The system is designed to fully transportable to vessels of opportunity throughout the world. Design applications include:

I. Telecommunications cable inspection and route evaluation
I. Pipeline inspection and route evaluation
II. Regional surveys in support of construction related studies
III. Regional surveys in support of environmental assessments
IV. Search, locate and identification requirements

INTEGRATED SYSTEMS

The fully integrated FOCUS 1500 high resolution system includes:

I. FOCUS 1500 vehicle
II. Laser Line Scan (LLS) System
III. 240kHz multibeam
IV. 100kHz side scan sonar
V. Magnetometer
VI. Integrated navigation system with USBL tracking

FOCUS 1500 Vehicle (ROTV) (Figure 1)

The MacArtney A/S FOCUS 1500 ROTV is a fully instrumented and integrated vehicle package which can support multiple sensors for conducting controlled, stable platform surveys to water depths of 1500m. The system is capable of flying excursions of up to 50 meters - left, right, up, down- from its centered tow position. Included in the onboard instrumentation are sensors for detecting/monitoring tow attitude, roll, heading and pitch. The system is designed to be slightly positive in buoyancy, weighing 1200 lbs (500 kg) in air and measures 2.6x1.5x1.54 meters in overall size. The system is currently operated on a 4000 meter long fiber optic electro-mechanical tow cable.

Laser Line Scan System-LLS (Figures 1, 2 and 3)

A Northrup Grumman (formerly Westinghouse Electric Corporation) SM 2000 Laser Line Scan (LLS) system has been fully integrated into the complete package. The LLS system produces high resolution "picture quality" panoramic image surveys at rapid coverage rates. The basic system consists of the underwater optical sensor and the topside control console. Laser scanning, in essence, can be described as the building up of an image from a rapidly acquired series of spots on the seafloor, each sequentially illuminated by a pencil sized diameter laser beam. Display options include video, frame-grabbed stills and photographic hard copy.

Multibeam System (Figure 1)

A RESON Model 8101 240 kHz multibeam system provides high resolution swath bathymetry to depths in excess of 1800 meters water depth. Key components of the system are the hardware products built by RESON and the proprietary survey support software developed by SAIC. The system provides the following key features:

I. 100 beams with a vertical resolution of better than 0.2 meters
II. 150-degree swath widths
III. Phase and Amplitude bottom detection
IV. Greater than 3000 soundings per second

Display elements include real-time swath coverage monitoring, false light shading, contouring, color shading, profiling and related techniques, all aboard vessel.

Side Scan Sonar System (Figure 1)

A KLEIN M-595 digital side scan sonar system has been integrated to provide side scan imaging capabilities for 100-400 meter wide swaths. The system operates at 100 kHz, sampling the seabed between 4-16 times per second. The system is capable of detecting targets to less than 0.5m in size. Display options include hard copy, video and computer enhancement.

Magnetometer

A Geometrics cesium magnetometer has been integrated into the system for detecting events at the sub-gamma level. The system proved to maintain a background level of extreme quiet and could detect known telecommunications cables throughout the operating depth range of the system (600m/wdin this operation).

Integrated Navigation System and USBL Tracking

SAIC has incorporated versions of its proprietary ISS 2000 integrated navigation software for providing survey and tracking control on the vehicle. Key features of the system include:

I. Fully integrated PC controlled navigation system with multiple monitor displays for helmsman and operators
II. Multiple LOPs input, real-time swath assessment and coverage analysis
III. Krongsberg - SIMRAD, Model HPR 410 "full ocean depth" tracking for operations to 1500m water depths

OPERATIONAL CONSIDERATIONS

Figures 4 and 5 demonstrate the operational capacities of the individual sensors and demonstrate the optimum multi-sensor mode application of the system. Real applications tow speeds have varied between 2-4 knots, operational applications of the full system have varied continuously between 20-1500 meters water depth. For planning purposes the following maximum water depth limitations apply for the various imaging systems:

I.	Laser Line Scan	1550 meters
II.	Multibeam	1800 meters
III.	Side Scan Sonar	1550 meters

Data Products

Existing data products are provided herein for review. In summary these products include:

- Laser Line Scan (Figure 6):
    - Continuous video tape
    - In-field digital frame grab of individual targets
    - Post survey processing:
        - Linear and regional mosaics of continuous data in hard copy
        - GIS data base of isolated and continuous data provided on CD-ROM or as a Web Site
- Multibeam (Figure 5):
    - Various color encoded visual displays in real-time and post-processed
    - "False-lighting" displays from any operator selectable angle (side scan sonar type imagery)
    - Soundings, contouring, 3-D isometrics, profiles
    - Provided in hard copy, CD-ROM or as a Web Site

Side Scan Sonar:

Standard hard copy, digital and mosaic capabilities

Provided in concert with GIS data bases listed above also on CD-ROM or Web Site format

CONCLUSIONS

A MacArtney A/S FOCUS 1500 remotely operated tow vehicle (ROTV) has been fully instrumented by Science Applications International Corporation (SAIC) to conduct intermediate-to-deep water survey and search operations. During the Summer and Fall of 1997 the system was operated in a variety of locations around the world including the East Coast of the United States, Hawaii and the North Sea. Applications included testing and evaluation, cable route assessment, academic research, pipeline route assessment and seabed hazards assessment. The fully integrated system supports multiple sensors, including high resolution acoustic systems, imaging sensors and magnetic sensing devices.

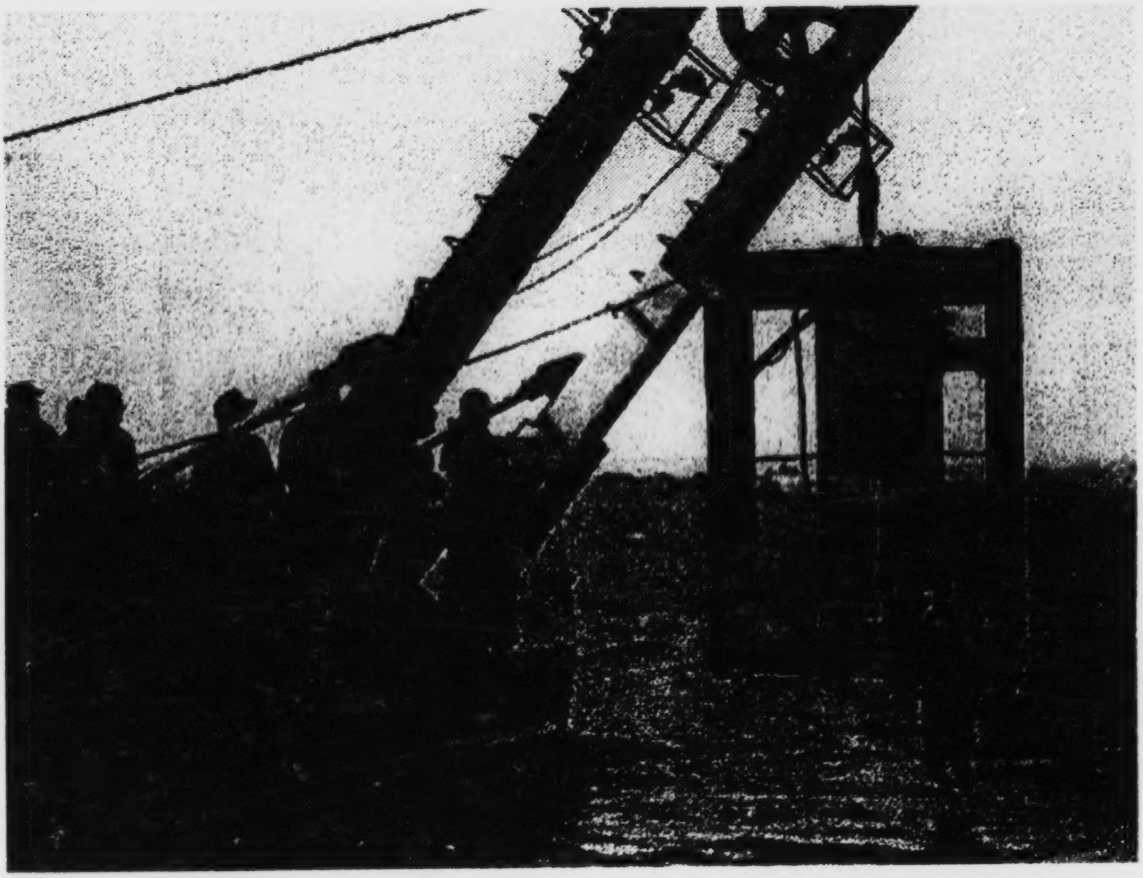

Figure 1

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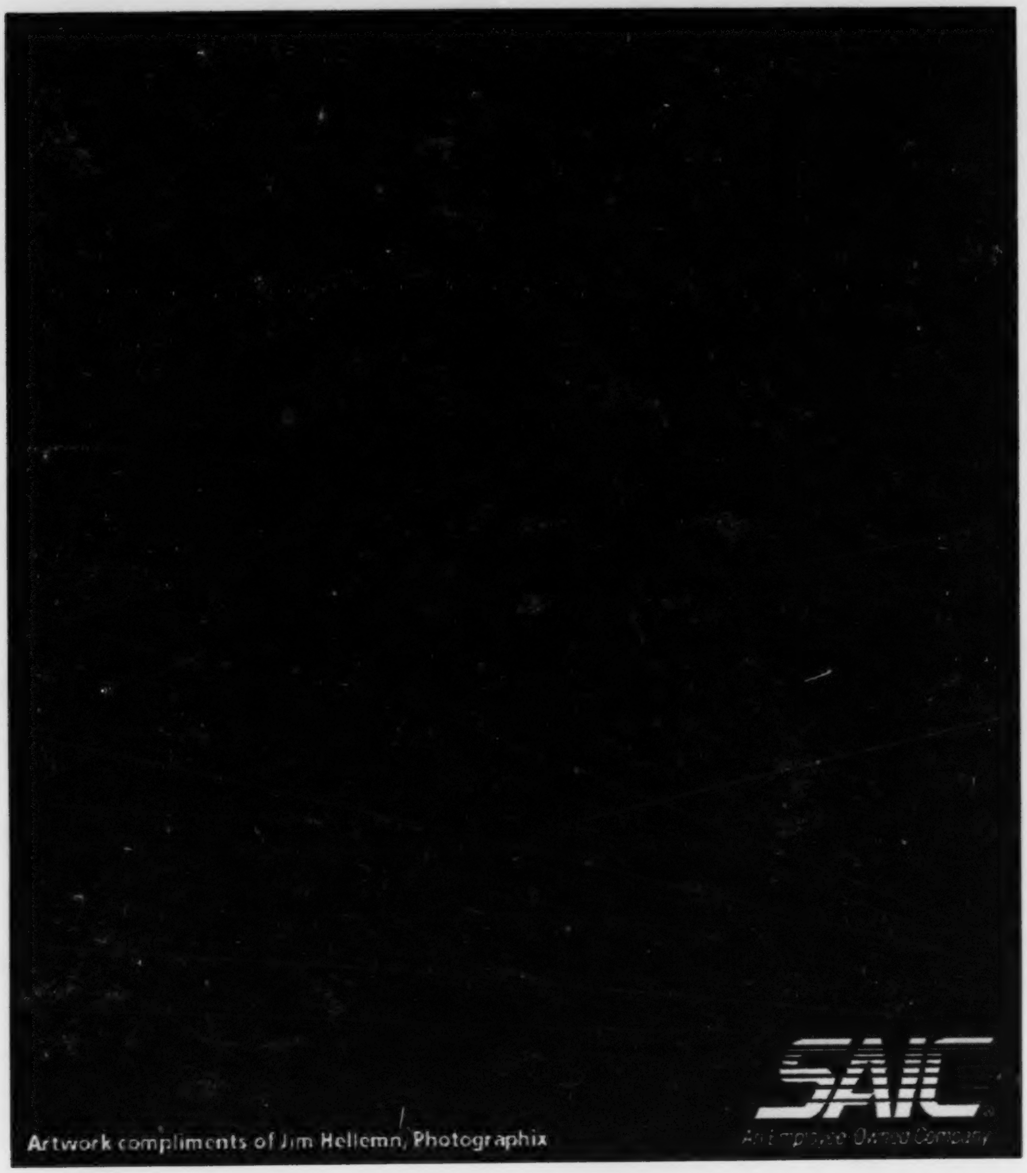
Artwork compliments of Jim Hellemn, Photographix
SAIC
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Figure 2

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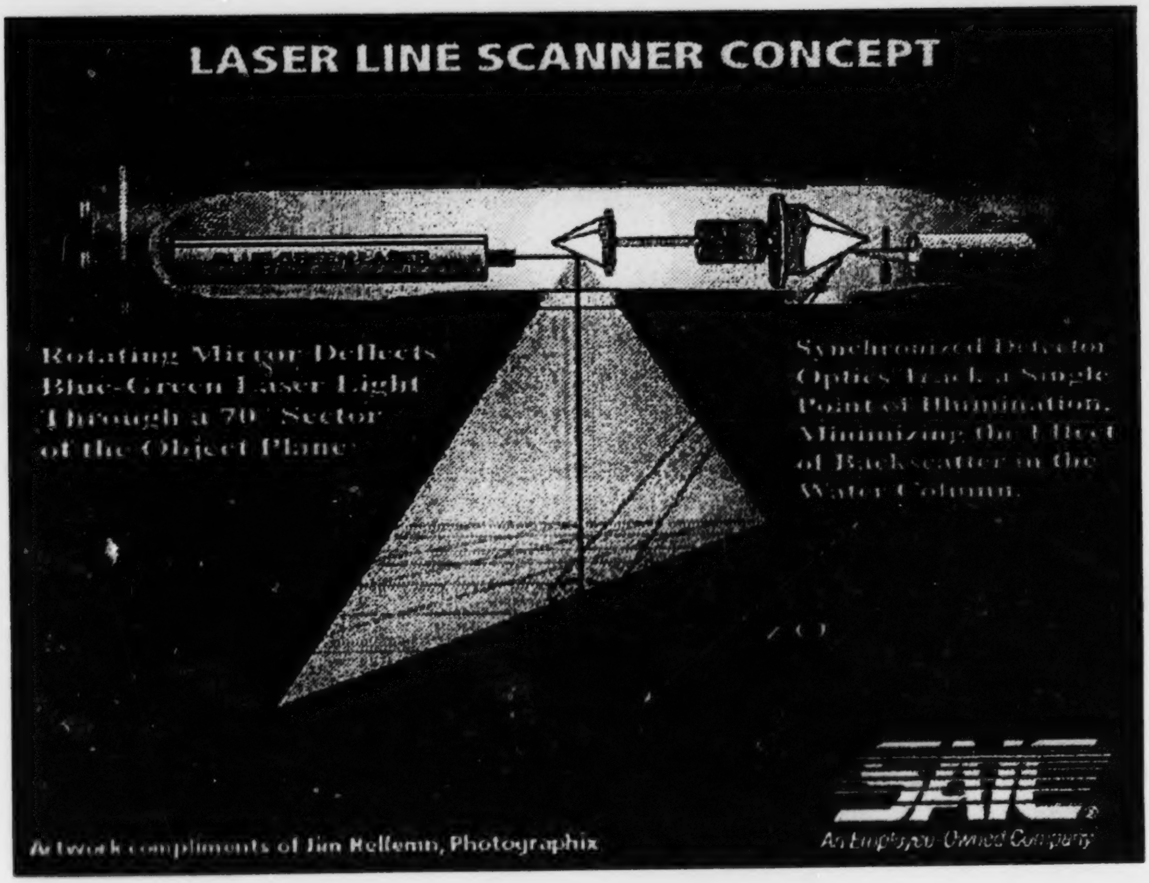

LASER LINE SCANNER CONCEPT

Rotating Mirror Deflects Blue-Green Laser Light Through a 70° Sector of the Object Plane

Synchronized Detector Optics Track a Single Point of Illumination, Minimizing the Effect of Backscatter in the Water Column.

Artwork compliments of Jim Hellemn, Photographix

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FIGURE 3

AVAILABLE

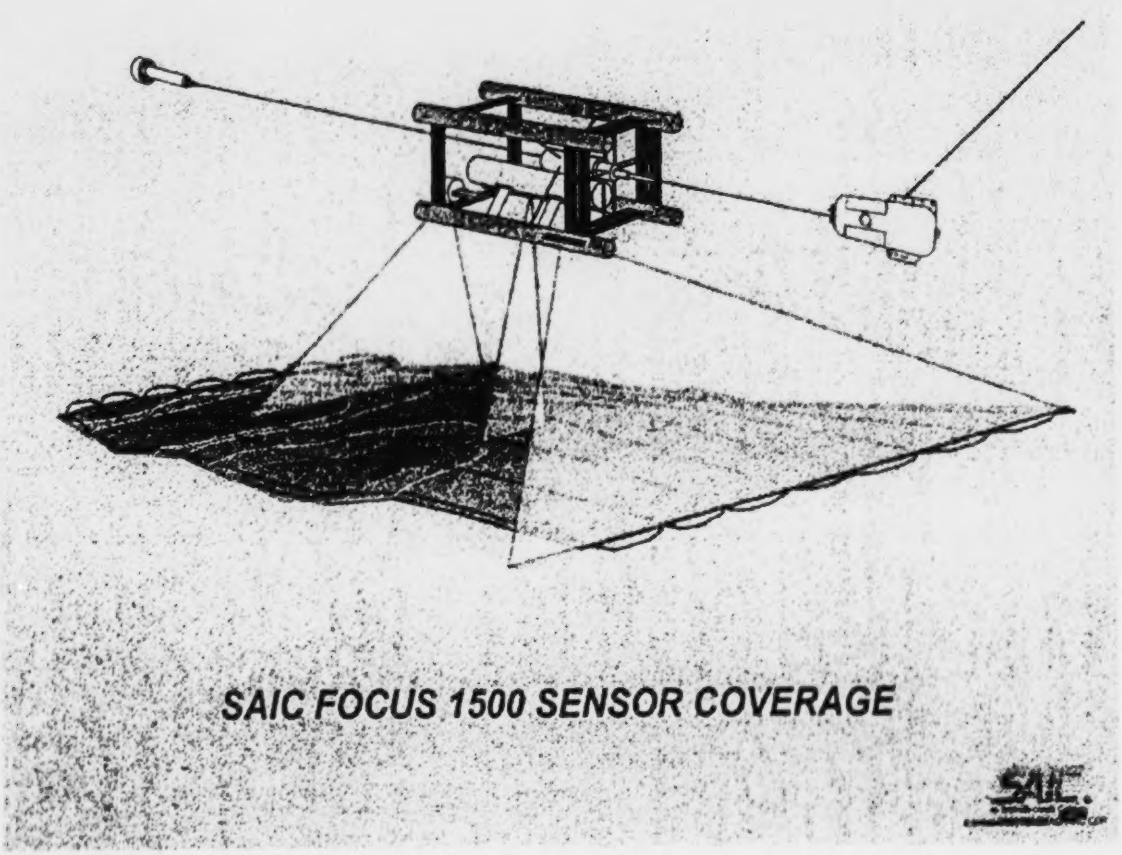
SAIC FOCUS 1500 SENSOR COVERAGE
SAIC.

Figure 4

SAIC FOCUS 1500

SENSOR PERFORMANCE vs. ALTITUDE

ROTV ALTITUDE (M)	MULTIBEAM SWATH (M)	MULTIBEAM BEAM FOOTPRINT AT 45 (M^2)	OPTICAL SIDE SCAN SONAR SWATH (M)	SIDE SCAN RESOLUTION AT MID-SLANT RANGE (M)	LASER LINE SCAN SWATH (M)	LASER RESOLUTION (M)
5	37	0.1	75	0.07	7	0.007
10	74	0.3	150	0.13	14	0.004
20	148	1.1	200	0.87	28	0.028
30	222	2.5	400	1.75	42	0.042
40	296	4.4	500	2.18		
50	370	6.9	600	2.62		
60	444	9.9	800	3.49		
70	518	13.4	1000	4.36		
80	578	17.6				
90	572	22.2				
00	566	27.4				
120	550	39.5				
140	531	53.8				
160	508	70.2				
180	480	88.9				
200	447	109.7				
250	332					
300	0					

Figure 5

Figure 6

The Asia Pacific Satellite Market
After 2000

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1. ABSTRACT

Analysis of the drivers of the demand for GEO satellite services in the Asia Pacific indicates that this market is far from running out of steam, although recent economic problems indicate a slowdown in the short term. The region has some troubling problems, some of which could be alleviated by technological and business solutions. On the other hand, several interesting business trends are emerging. Five countries in the region are developing capability to build satellites and systems, and satellite manufacturers in Europe and the US should position themselves to benefit from these developments.

2. INTRODUCTION

The rate of growth of satellite communications and broadcasting services in the Asia Pacific region is unprecedented. At the start of 1975, fixed point-to-point satellite services to the region were provided by three Intelsat-4 series spacecraft carrying a total of 36 C-Band transponders, each of six watts. A decade later, at the beginning of 1985, there were 25 satellites in service carrying 310 transponders, with seven operators. The most powerful transponder was 200 watts on a Russian satellite, and Ka-Band and the UHF spectrum were already in use. Direct-To-Home TV had started in the previous year.

A further ten years on, in January 1995, there were 940 transponders on 59 satellites with 19 operators. In the decade between 1975 and 1985, 274 transponders, 22 satellites and six operators had been added. In the subsequent decade those numbers were 630 transponders, 34 satellites and 12 operators. The rate of growth had doubled, but the pickup was just starting.

Three years later, at the beginning of 1998, the number of active transponders in the region is over 1800 on nearly 70 satellites. In just three years the nett increase in transponder numbers is nearly 100%. Nine new operators have entered the market in these three years.

What are the prospects for three years further on, and beyond? The total number of operators by 2000 could be as high as 38. AsiaSat has estimated regional demand to require 300 to 460 additional transponders per year, depending on the growth assumptions.

This paper reviews the drivers and trends impacting on demand in the Asia Pacific satellite market. It discusses issues with the potential to hinder growth, and developments that may facilitate growth. Finally, it describes the increasing capability within the region to supply satellites to this market.

3. DRIVERS IN THE ASIA PACIFIC MARKET

Prior to the economic events in Asia over the last four months, prospects appeared good for the present rate of deployment of GEO satellites for service in this region to continue. Euroconsult estimated in 1995 a demand for 86-109 new communications spacecraft through 2005, an average of 9-11 per year and a $US7b to $10b market. The recent trend supports these numbers. Eight GEO satellites were launched in 1995 for service in this region, thirteen in 1996, and seventeen in 1997.

Future demand in the region will depend on economic progress and the fallout from recent developments, on the drivers for growth (now and in the future), and on the influence of public policy.

3.1. IMPLICATIONS OF ECONOMIC DEVELOPMENTS

Substantial currency devaluations in southeast Asian countries in the third quarter of 1997 led to stock market adjustments around the world and IMF intervention in several regional countries. The effects are likely to be mixed in the short to medium term, but positive for long term prospects. Devaluations have put added pressure on regional satellite operators who raised funds in US dollars but collect revenue in devalued local currencies, and the general slowdown in economic activity is adding pressure to those revenues. On the other hand the correction is leading to greater transparency in business dealings in the region, tighter government budgets and other reforms with positive potential for long term growth. National economies are likely to experience reduced growth in the short term, but growth rates will still be substantial.

3.2. TELECOMMUNICATIONS

The demand for telecommunications remains high in the region. According to the Asia-Pacific Satellite Communications Council (APSCC), the 180 million switched terrestrial telephone circuits in the region at the end of 1995 are expected to reach 250 million by 2001, with annual growth at 15-20%. Even so, Asia still has less than 20% of the world's telephones for half the world's population.

Terrestrial infrastructure cannot be installed as cost-effectively as satellite capacity in many countries. The 2.5 million switched satellite circuits at the end of 1995 are expected by the APSCC to reach 3.5 million by 2001, roughly equivalent to 3,300 satellite transponders of 33 MHz each. This would require a further doubling of transponder numbers over the next three years. Currently Asia has around one transponder per 2.4 million population compared with one per 300,000 in the US, notwithstanding the growth in capacity over the past few years.

Economic growth continues to fuel demand by business and private subscribers for basic and value added services. Business has difficulty securing the services it requires, and Asia's 400 million middle class consumers comprise a potential market larger than either North America or western Europe. The penetration of basic telephone services remains very low in some countries; in Indonesia it is 1.65%, in India 1.3%, in Vietnam 1% and in Myanmar 0.5%.

Deregulation is playing a part in this growth in demand. Competition has been introduced into many national telecommunications markets, though far from all of them. Australia, Hong Kong, Japan, New Zealand and the Philippines are regarded as doing well, while Brunei, Singapore, Taiwan, Thailand and Vietnam and considered to be moving slowly. The World Trade Organisation accord on telecommunications services is adding pressure on governments to open markets. As new services are introduced into newly competitive markets, service prices are falling and traffic volumes are going up.

3.3. BROADCASTING

Broadcasting is a strong growth area, including video relay for terrestrial TV, Direct-To-Home TV (DTH) and satellite radio. In 1996 DTH services opened in Indonesia, Japan and Malaysia. In 1997 Australia, China, India, South Korea, the Philippines and Taiwan launched digital services, and the number operating in Taiwan increased. The APSCC estimates that the 10.5 million DTH receivers in the region in 1994 will grow to 50 million by 2001, by which year the number of satellite digital TV channels is expected to reach between 1,500 and 2,000. At an average of eight channels per transponder, that translates into 190 to 250 DTH transponders. The launch of satellite digital radio in the region late in 1998 represents a further expansion of this market.

Government policies restricting or prohibiting direct reception of satellite TV are hindering the prospects of DTH services in some countries, though blanket enforcement has proved impossible. India and China, the biggest potential market, are two such countries. The primary imponderable in China is how the successors to the present leadership will manage the demand for political change, which inevitably accompanies economic change. While it seems unlikely that the pace of economic development will drop dramatically, a slowdown might relieve pressure on those resisting liberalisation. The ban in India appears to be a holding action designed to permit an indigenous DTH industry to become established before facing full international competition. It is already under legal challenge, which it may not survive.

The largest unknown in the field of entertainment services is perhaps video-on-demand, which has yet to become fully established in the region. Satellites can deliver these services earlier than terrestrial systems, which require cable to be rolled out or microwave to be installed. This new service also has the potential to require lots of bandwidth to deliver hundreds of channels.

3.4. MULTIMEDIA SERVICES

Multimedia services, including interactive services and the Internet, are also growing strongly and making increasing use of satellites. In the last two years Internet use in Malaysia grew 600% (though off a relatively low base), in Hong Kong 278%, in Japan 273% and in Australia 166%. In December 1996 Intelsat was using the equivalent of three transponders worldwide for Internet traffic, but the increasing demand is such that only five months later the organisation expressed concern at its ability to cope.

Intelsat's concern mirrors warnings expressed elsewhere, that Internet traffic growth rates are so high that the service will soon compete with voice and data for capacity that suddenly may become more limited than network planners anticipated. Telcos, satellite operators and multimedia investors have to take account of the extremely high Internet growth rates in the Asia Pacific region. If the current trend continues, the demand for bandwidth will require increasing satellite capacity well into the next decade.

The developing market for high-speed data and video services will also have an impact in this region. While DTH TV was a major driver for regional satellites launched in 1997, high speed data and video will figure more prominently from 1998 onwards. Indonesia's Multi-Media Asia (M2A) satellite, due for launch late in 1998, is perhaps the first of this next wave.

3.5. MOBILE COMMUNICATION

Mobile communication using hand-held terminals – another market yet to develop - is also a driver. This market will to an extent be served by the global LEO and MEO systems, of which Iridium and Globalstar are already being deployed. The Asia Pacific should see the commencement early in 1999 of the first regional handheld mobile service operating from a geostationary satellite, Asia Cellular Satellite System (ACeS). A second system, Asia Pacific Mobile Telecommunications (APMT) has suffered funding delays that suggest its future is uncertain. A third system, the Thuraya program led by Etisalat of the United Arab Emirates, will commence services in 2000.

One competitive advantage claimed for the GEO systems is lower airtime charges, though actual rates have not been announced. What may prove to be even more attractive is the integration of GEO-based mobile services with fixed satellite services. PT Pasifik Satelit Nusantara (PSN) of Indonesia is moving in that direction. PSN is a partner in ACeS and will operate the program's satellite control centre. Its companion Multi-Media Asia (M2A) satellite program will deliver telephone services and TV channels directly to homes throughout the region. The footprints of ACeS and M2A are similar, though not identical. PSN will integrate the two systems, allowing subscribers to use a single phone number and switch between services. This powerful concept suggests a promising future for integrated services catering for the regional market at appropriate pricing levels.

3.6. SOVEREIGN RISK

Political stability represents a potential risk element for the future of this market. Could there erupt a political event so dramatic as to break current trends? Certainly there are zones of international tension within the region, with the potential to erupt. There is instability in North Korea and tension with South Korea, China has a tense relationship with Taiwan (and is involved in the Paracel and Spratly Islands disputes, which potentially involve Brunei, Malaysia, the Philippines, Taiwan and Vietnam), and there is instability in Indo-China (notably in Burma and Cambodia). Of these, perhaps the Korean peninsula and the Taiwan straits are the regions with most current potential to erupt on a scale sufficient to disrupt the region.

On the other hand most governments in Asia, both socialist and capitalist, plan far into the future, as do many companies. Five-year plans and 20-year horizons are common, and the current growth should be seen in that context. Most regional leaders now accept that political legitimacy comes more from delivering on the promise of economic development than from military adventures. We tend to believe that the market will continue without major dislocation from this source.

4. CURRENT TRENDS AND ISSUES

Some developments in the regional GEO market point to trends with potential. Others reflect issues of continuing concern.

4.1 COOPERATION AND CONSOLIDATION

Cooperation agreements, such as that between the operators of the Measat and Thaicom systems, may be the harbingers of greater regional collaboration, and perhaps eventually consolidation. There is substantial footprint overlap between many of the satellite systems, especially those offering DTH services. For those systems focussed on the region, rather than primarily on a single country, prime markets include Chinese-speaking populations (China, Taiwan, and Singapore), major economies

(Japan, China, Korea, Australia, India, and Taiwan) and major populations (China, India, Indonesia, and Japan). To date it has been difficult for TV broadcasters to make DTH services profitable, and it would not be surprising if some saw wisdom in reducing overheads through collaboration in addressing similar markets.

The added financial pressure on some operators following the recent devaluations and the economic slowdown will provide more impetus to investigate possible collaboration opportunities, both for synergies in business growth and to reduce costs.

4.2. REGIONAL RESPONSE TO GLOBAL COMPETITION

While satellite operators in the region are building business in core national and regional markets, they are well aware of the plans of global operators to offer competing services in the Asia Pacific. PanAmSat (now owned by Hughes, and part of that company's global strategy) already offers global services and plans to double the number of satellites serving the Asia Pacific in 1998. Intelsat is soon to spin off a commercial subsidiary, being referred to as "Inc", and the high powered DTH satellite ordered for the 95°E location is likely to become part of the Inc network. Columbia is providing transpacific services on NASA's TDRS satellite and will launch its own Pacific satellite in 1999. Loral Space and Communications has acquired AT&T Skynet Satellite Service and Orion Network Systems in a global strategy, and will deploy the first Orion Asia Pacific satellite in 1998. Lockheed Martin has joined with Intersputnik and gained access to 15 slots around the globe, listing southern Asia amongst target markets. Russia will itself offer services in the region on new HS-601 satellites recently ordered.

What might be the response by operators in the Asia Pacific to ITU filings in this region by global competitors? Some may collaborate, but others may choose a more aggressive strategy. The financial capacity in the region is still quite sufficient to underpin a global response from Asia. We would not be surprised to see equivalent filings for orbital locations serving North America and Europe.

4.3. BANDWIDTH, FREQUENCY AND POWER TRENDS

Market demand for DTH, mobile and broadband services is reflected in increasingly powerful satellites and increasing size. Agila-2 and Apstar-2R are the current regional "hot birds" with 8 kW, but Hughes' new HS-702 will launch in 1998 with 15 kW and Space Systems/Loral's La Fayette will launch in 2000 with 16 kW. Aerospatiale is building the Spacebus 4000 with 20 kW. These large and powerful platforms offer the Asia Pacific the opportunity to fit more transponders on a platform, to some extent reducing pressure for slots in the region.

Demand for bandwidth accompanies the demand for power. The APSCC predictions of demand for satellite circuits and DBS transponders by 2001 correspond to around 120 GHz of bandwidth. Ku-Band has rain attenuation problems making it uneconomic to use for high quality voice services, especially in the tropics, and Ka-band is worse. Some have started to think about X-Band, where 1 GHz of spectrum may be available and the rain attenuation problem is reportedly less.

4.4. PRESSURE FOR SLOTS

There is a growing problem in the overcrowded geostationary orbit in the region. The demand for capacity, a strong entrepreneurial spirit, and the lack of authority vested in the ITU represent a potent combination for disputation. Two recent examples illustrate how pressing the problem is becoming. One is at 134°, the other at 144°.

Apstar-1a (owned by APT Satellite of Hong Kong) currently operates at the 134° location, which is claimed by both Tonga and Indonesia. PSN claims to have registered this location in 1993 but Tongasat claims an agreement in that year permitted PSN to share the slot for a limited time. PSN asserts that Apstar-1a is not properly coordinated with other users, and is alleged to have jammed Apstar-1a signals early in 1997.

Japan's Superbird-C took up location at 144° after launch in July. It is registered at that location for Ku-Band, the only Band in which the Superbird operates. The slot is also registered to Indonesia for C-Band only. By agreement with Indonesia, the Philippines has sought official co-ownership of the 144° slot to accommodate the Agila-2 satellite of Mabuhay Philippines Satellite Corporation (MPSC) following its launch in August. However Agila-2 operates in both C and Ku-Bands. Achieving acceptable levels of non-interference may well require power and frequency constraints, and a minimum separation of 1.6° is normally required. Coordinating frequency between the two satellites is therefore expected to require ongoing attention.

Facilitating resolution of slot disputes was hoped to be a function of the Asia-Pacific Satellite Communications Council when it was formed in late 1994, but the APSCC appears to have had no more discernible impact on the problem than the ITU whose endorsement it enjoys. Coordination continues to be pursued on a bilateral basis, consuming time and energy and adding a layer of complexity to satellite design and operation.

Limited relief may come from increased compression ratios, as well as higher satellite power levels and frequencies. Speaking at a conference in London early in 1997, Koos Bekker of NetHold (the company that owns Irdeto) forecast that research might by early next decade permit digital signal compression ratios of 1,000 to one. This is not necessarily the harbinger of reduced demand, for the arrival of digital compression served to increase demand, not decrease it. Rather, much higher compression ratios could greatly reduce the pressure on bandwidth, frequency spectrum and orbital slots. A further huge increase in usage could result, offering regional communities greater access to services, real time interactivity, and convergence of computing with TV.

4.5. STARTUP STRATEGY

One problem facing the new satellite operator is how to establish cashflow ahead of the launch of the first purpose-built satellite. Two new Philippines operators, MPSC and Philippine Agila Satellite Inc (PASI) started business by leasing satellites. In August 1996 MPSC leased from PSN of Indonesia the former Palapa-B2P at 113° and moved it to 144° to provide services ahead of the launch of MPSC's own first satellite, Agila-2. The primary objective was to provide services for the meeting in Manila in November 1996 of the leaders of the Asia Pacific Economic Council. Palapa-B2P was retired in March 1997 and did not continue in service through to the launch of Agila-2 in August 1997.

In a similar move PASI, (who have experienced difficulty getting their program funded and into service) arranged in January 1997 to lease for two years the elderly Gorizont-29 at 130°. The Gorizont was relocated to 161° to provide C-Band services in its global beam and Ku-Band services to Korea, Japan and Taiwan, though we understand this particular venture did not proceed. It was recently confirmed that Aerospatiale had ceased work on PASI's first satellite (which to be launched late in 1998) due to payment difficulties.

Orion Asia Pacific seems likely to use this strategy prior to the launch of its first satellite, also expected late in 1998. It has been negotiating for capacity from Intelsat, Satelindo or APT Satellite.

As the GEO population builds, more ageing satellites may well become available at attractive prices prior to retirement. We will not be surprised to see future new operators in finding this approach attractive.

5. SATELLITE MANUFACTURE

The Asia Pacific represents the largest market for GEO satellites at this time, but to date regional companies have played only a limited role in supplying that market. Japanese companies are well regarded for their communications payload systems, but there is no regional prime contractor for commercial satellites. The suppliers of satellites purchased on the international market for service in the Asia Pacific currently are American and European - Aerospatiale, CTA (now part of Orbital Sciences), Lockheed Martin, Hughes, Matra Marconi Space and Space Systems/Loral. DASA of Germany has a co-operative agreement with China Aerospace, but has not itself supplied a satellite. Japan has built a series of Engineering Test Satellites and China and India have built their own operational communications satellites, but no-one has sold one on the international market. The lack of regional commercial satellite supplier is however soon to change, and other countries are developing capability.

5.1 CHINA

China launched its first communications satellite, DFH-15, in 1984 and has since launched another eight. However it has never sold a satellite to a foreign customer, and itself recently became a customer for satellites built overseas. It cannot therefore be regarded as a potential supplier to the regional market.

5.2 INDIA

India launched its first locally-built operational communications satellite, Insat-2A, in 1992 following the Insat-1 series that was built in the US. It has since launched four others, Insat-2B through 2E. Although no announcement has been made of intention to offer satellites on the commercial market, recent offers for commercial launch services on Indian launchers suggests this is possible. India must therefore be regarded as a potential supplier.

5.3. JAPAN

Japan has the engineering capability to build commercial communications satellites, as demonstrated in NASDA's Engineering Test Satellite (ETS) series. To date high manufacturing costs have deterred Japanese companies from entering the commercial market. Ever since the US launched its successful Super 301 action in 1990 to prevent 25% NASDA-financed satellites going into commercial service with NTT, Japanese satellite operators have consistently bought foreign satellites. Most of those satellites contain systems built by Japanese firms that have themselves recently confirmed ambitions to become commercial satellite manufacturers by 2005. Mitsubishi has committed $US600m for manufacturing facilities, NEC aspires to sell communications satellites to neighbouring countries, and Toshiba (which has a relationship with Space Systems/Loral) has signalled its interest. As with the H2 launcher however, huge cost reductions will be needed before Japanese-built satellites capture significant market share.

5.4. KOREA

Korea may beat Japan to the market. It has a national goal that future replacements for the Koreasat system be designed and built locally. Experience has already been gained in the Kitsat microsatellite program and in the 30% local content in the Koreasat-1 and 2 communications satellites. Hyundai Electronics Industries (HEI) is an equity partner in the Globalstar system, and will assemble some of the first generation of Globalstar satellites; it aspires to build the second generation in Korea. HEI is also acquiring technology through an association with Alenia Aerospazio of Italy. HEI has invested $US200m in a facility in which to assemble, integrate and test satellites sized up to the largest, and is supplying a Ka-band package for Koreasat-3, being built by Lockheed Martin.

In April 1996 the Korean Government announced a long-term space plan, to build and launch 19 satellites over the twenty-year period from 1996 to 2015, at an estimated cost of $US6b. The program will comprise seven scientific satellites, seven multi-purpose satellites and five communications satellites. The first multi-purpose satellite, KOMPSAT, is under construction at TRW in California for launch in 1999, under a $US60m contract. Six participating Korean companies have each contributed around $US5m to the KOMPSAT project.

5.5. SPACECRAFT SYSTEMS COMPETENCE

System manufacturing capability is also being developed in Australia, Malaysia, Singapore, Taiwan and Thailand. **Australian** companies developed space segment design and manufacturing capability in the late 1980s to support the local content requirements of the Aussat-B program. They also supplied systems to GE Astro for the Intelsat-8 program. Through the publicly funded National Space Program that operated from 1985 through 1996 they undertook feasibility studies, managed projects, and manufactured (and sometimes designed) complex scientific instruments, instrument subsystems and ground support equipment. At present Australia is planning two LEO missions (ARIES and FEDSAT) that will further develop industrial capability.

Malaysia has set up a government-owned company, Astronautic Technology Sdn Bhd, to fly a 50-kg satellite named TiungSAT-1 with the objective of gaining the ability to design, engineer, build and launch spacecraft. The program is funded with $US16m over two years. Surrey Satellite Technology (SSTL) of the UK have built the satellite and trained eight engineers to form the nucleus of an indigenous Malaysian space industry. TiungSAT-1 is expected to be launched early in 1998.

In **Singapore**, Nanyang Technological University built a communications payload to fly on the University of Surrey's *UoSAT-12* mission, launched in December 1997. It is studying a Singapore-owned micro-satellite or mini-satellite to be flown in equatorial LEO in 2000 or 2001. Developing local capability to build satellite components is one of the program objectives.

Taiwan established its space program as the vehicle for developing high technology industry. Its first project (ROCSat-1) is a satellite built with TRW, carrying communications, ocean colour scanning and ionospheric physics payloads. ROCSat-1 will be launched next April. Studies were under way on a second satellite (ROCSat-2), proposed as a Ka-Band GEO communications system with regional service capability, but the program has suffered setbacks and ROCSat-2 is not yet authorised.

Thailand is aggressively pursuing the capability to build satellites with the objective of becoming a regional leader. Several Thai Ministries have interests in active space programs. One is the National Research Council's Thai Remote Sensing Small Satellite (TRSSS) program, which has a secondary objective of building local capability. TRSSS was funded with $US116m, but experienced delays and is understood to have suffered in the recent economic crisis in Thailand. Other proposed programs are in the Ministry of Transport and Communications (for an international co-operative LEO project with several Asian countries) and the Ministry of Defence, whose ambitions for GEO and LEO satellites have also recently been frustrated by the Thai economic stringencies.

In the private sector, Thai Satellite Telecommunications Co Ltd spent $US12m on the 50-kg *TMSat-1* project in association with the Mahanakorn University of Technology. SSTL of the UK built the satellite, launched in December1997.

6. CONCLUSIONS

There are no convincing indicators that the growth of the Asia Pacific satellite market is yet running out of steam, though it may slow a little in the immediate future. Devaluations have put added pressure on satellite operators who raised funds in US dollars but collect revenue in devalued local currencies, and the general slowdown in economic activity is adding pressure to those revenues. However the WTO continues to press governments to free up telecommunications markets, and economic development continues to drive demand for improved telecommunications for both business and consumers. Low teledensities and increasing incomes mean that unmet demand for telecommunications will continue, and satellites will also continue to represent the most cost-effective solution in many situations.

Satellite broadcasting, particularly Direct-To-Home TV, is growing strongly. The impact of limitations imposed by governments in China and India seems likely to reduce, and video-on-demand is just starting with plenty of potential. Internet traffic, high-speed data and multimedia services, though quite new as significant factors in the demand equation, seem likely to require substantial additional capacity.

Regional satellite mobile services will face competition from global operators, but may find their strongest attraction in integration with fixed services addressing market segments of special significance in Asia. We expect the number of satellites offering these services to grow, but not to comprise a major part of the market in the near future.

Two of the biggest issues facing regional operators are pressure on the geostationary orbit and competition from global operators. Although slot disputes are likely to continue in the near term, technological and business solutions could reduce this problem in due course. The pressure from global competitors will increase however, and we will not be surprised to see an aggressive response from the Asia Pacific community.

On the supply side, organisations in Japan and Korea are planning to become prime contractors supplying spacecraft to this market, and India may join them. Firms in Japan, Korea and Australia have the capability to supply spacecraft systems, and others in Malaysia, Singapore, Taiwan and Thailand will soon have that capability.

Satellite manufacturers in Europe and the US have a watershed decision to make with respect to this development. They could seek strategic partnerships with the regional firms building this capability. This would accord with the business culture of Asia, which is built on networks. Alternatively they could maintain their traditional attitude to the local content requirements on which Asia is in part building capability. That attitude can be characterised as minimum compliance and earliest possible exit from obligations. That course is highly likely to generate aggressive and increasingly-competent competitors with a marketing edge in the Asia Pacific market.

In summary the world's largest market for GEO satellites is going to get bigger in the foreseeable future. As it does, and develops the capability to supply satellites, regional operators and manufacturers will increasingly adopt broader, and eventually global, strategies. Those companies outside Asia that understand the dynamics and culture of this market have the opportunity now to position themselves to benefit from these developments.

Addressing the Global Evolution in Telecommunications Services with Space-based Systems and Technologies

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1. ABSTRACT

The rapid growth in global telecommunications is causing progressive evolution of telecommunications services which is tied to each region's economic and infrastructure development. A variety of space-based solutions exist which provide a mechanism for keeping pace with the rapid regional changes in user demand for services. In many parts of the world, fixed satellite services (FSS), mobile satellite services (MSS), direct broadcast services (DBS), and global broadband services (BBS) allow a much more rapid and cost-effective deployment of next generation services than do terrestrial, wireline-based solutions. Advances in satellite technology will support flexible and reconfigurable systems to address the wide variation in global user demands expected in the future.

2. INTRODUCTION

A huge, unsatisfied, global demand for telecommunications services exists today and will continue to increase over the next ten to fifteen years with the expansion and integration of the world economy. This demand will result in an expanding market for the entire range of telecommunications services, from basic telephony and broadcast TV, to the most advanced digital data communications networks supporting distributed multi-media applications and delivering bandwidth-on-demand.

To date, the historical evolution of commercial telecommunications services and service delivery methods has been primarily defined by the world's industrialized nations which were generally the first to introduce wide spread use of each service and delivery technology. As expected, the complexity of both the services and the delivery methods have increased over time. Today, however, rapid technological changes are driving down the cost of both basic and advanced telecommunications services, resulting in a break in the historical paradigm. Advanced services are now being introduced simultaneously in industrialized and developing regions.

The satellite service market can be divided into four segments: 1) FSS, 2) DBS or Direct-To-Home service(DTH), 3) personal satellite service (PSS) and 4) BBS. PSS can be further subdivided into mobile and fixed wireless service (MWS/FWS). This paper is focused primarily on geostationary (GEO) satellites. Low and Medium Earth Orbiting (LEO/MEO) are discussed later in the paper for comparison purposes. GEO satellites maintain a stationary, equatorial orbit 35,786 km above the earth. LEO and MEO satellites move relative to the earth's surface at much lower orbital altitudes than GEO satellites.

Telecommunications markets are dependent on regional economy and existing telecommunications infrastructure. However, these different space-based solutions will allow operators the ability to keep up with the rapid changes in user demand for services at both regional and national levels regardless of the variations in the economies and telecommunications infrastructures within a coverage area. In addition, these solutions generally provide a more rapid and cost effective deployment of services than do traditional, wireline solutions. Thus, advancements in satellite technology will make space-based telecommunications services more affordable, and accelerate their introduction into non-industrialized regions of the world.

3. TELECOMMUNICATIONS MARKETS, SERVICES, AND SUBSCRIBER ASSESSMENTS

Industry analysts project the telecommunications industry will triple in size by the year 2000. This growth will drive satellite communications to expand rapidly on a global scale within the next five years. Table 1 lists the expected revenue growth for satellite-based communications services in each of the aforementioned market segments (3).

TABLE 1: PROJECTED SATELLITE COMMUNICATIONS SERVICES REVENUE GROWTH

Type of Service	Value in 1996($B)	Value in 2000($B)	Annual Growth Rate
DBS	4	12	32%
MSS	0 - 1	8	75%
FSS / BBS	5	9	14%
Total	9	29	34%

Worldwide teledensity (defined as the number of main phone lines per 100 people) is expected to double from nine to eighteen between 1990 and 2010. The present teledensity of an industrialized region such as North America (approximately 60 main lines per 100 people) provides a good indication of the higher levels that global teledensity will reach beyond 2010 (2).

Despite this huge increase in telecommunications infrastructure, the growth in demand for telephony services is projected to be even greater. The number of people waiting for telephone service grew from 12 million in 1985 to 35 million in 1995. The cost of the infrastructure required to satisfy the unmet telephony demand is estimated to have been $3 trillion in 1995 and $5 trillion in 1997, and continues to increase (1, 2).

Some regions have millions of people waiting for telephone service, while in others it is available on demand. The low number of main lines per capita in the developing and emerging regions has generated worldwide waiting lists of 30 to 40 million people for basic telephone service. The associated wait times vary from a few months to greater than ten years, with 1.1 years being the world average. Table 2 shows waiting periods for several emerging, developing, and industrialized countries (2).

TABLE 2: TELEPHONY WAITING PERIODS IN SELECTED COUNTRIES

Country	Waiting Time (yr.)	Country	Wait Time (yr.)
China	0.2	Greece	0.6
India	1.3	Mexico	0.3
Kenya	6.6	Germany	0.0
Thailand	1.9	US	0.0
Philippines	3.6	Japan	0.0
Indonesia	0.2	Australia	0.0
Czech Republic	3.3	Korea Republic	0.0
Argentina	0.2	Viet Nam	1.1

In addition to fixed telephony services, all other telecommunications market segments including fixed telephony, personal communications services (PCS), cellular markets, internet growth, corporate intranet growth, direct-to-home (DTH), video teleconferencing and network services are also projected to increase dramatically on a global basis in the next five to ten years.

A central issue on everyone's mind is how this global growth will be distributed across the various regions of the world. For the purpose of this paper, the global telecommunications market is segmented into emerging, developing, and industrialized regions, as indicated in Figure 1 (1).

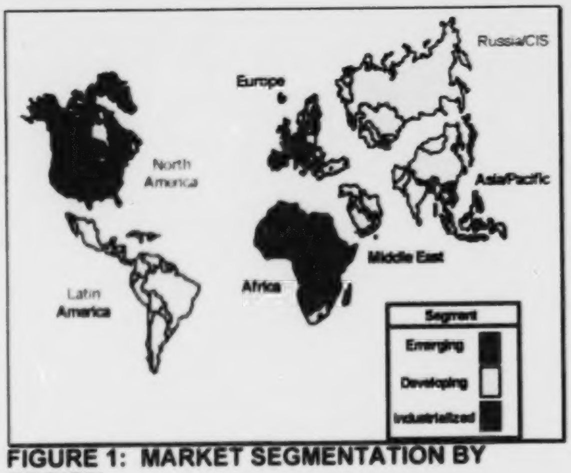

FIGURE 1: MARKET SEGMENTATION BY REGION

The rapid growth in the demand for global telecommunications is causing an evolution of telecommunications services in every region of the world. However, because some regions already have extensive and sophisticated telecommunications networks, while others have little or almost none, the evolution is not uniform in every region. For example, taken as a whole, Asia and the Pacific Rim is a developing region which is experiencing tremendous growth in telecommunications demand. However, individually, the nations in this region cover the entire economic and telecommunications infrastructure spectrum.

There exists a strong positive correlation between a region's GNP (a measure of economic development) and its teledensity (a measure of telecommunications infrastructure). For example, industrialized regions with high GNPs tend to have higher teledensities. Similarly, emerging regions with low GNPs tend to have lower teledensities. This has been the regional trend for about the last ten years. Figure 2 shows worldwide teledensity and GDP per capita doubling between the years 1990 and 2010 (1).

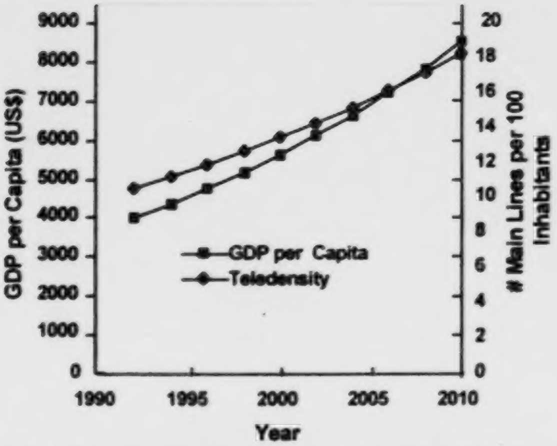

FIGURE 2: GLOBAL GROWTH OF TELEDENSITY AND GDP PER CAPITA

The Asia-Pacific region is estimated to maintain a high growth rate through 2005 and possibly longer. At current growth rate projections, the Asia-Pacific region's percentage share of both the world's total international telephone traffic and the world's total number of main lines will converge towards the same value (about 25%) by 2005, coming close to its percentage share of the world's GDP (also about 25%). Asia's portion of the world's wealth is predicted to rise significantly over the next decade which will positively affect the development of telecommunications services in that region (12).

The growth of basic television service provides an example of regional variations in the telecommunications services evolution of industrialized nations. Recent growth in basic television service has been small in the industrialized and emerging markets, but it has shown marked increase in the developing regions. In the industrialized nations most people who want a television already have one, along with access to basic services. The majority of people in the emerging regions can not afford a television, and/or they do not have access to television content. However in the developing regions of Asia and the Commonwealth of Independent States (CIS), the growing economies are supporting the demand for television services and the number of television users is growing rapidly.

In contrast, the rapid expansion of DTH television service provides an example of an advanced telecommunications service being introduced and growing simultaneously in both industrial and developing regions. The reasons for this are that DTH offers a competitively priced alternative to existing cable offerings in regions where cable is already available, and it provides a cost effective method to deliver high quality, high capacity television services to developing regions with no existing broadcast or cable infrastructure. Figure 3 illustrates the convergence of cable TV and DTH monthly subscription costs in Asia. DTH, however, is still more expensive on average than cable TV (11).

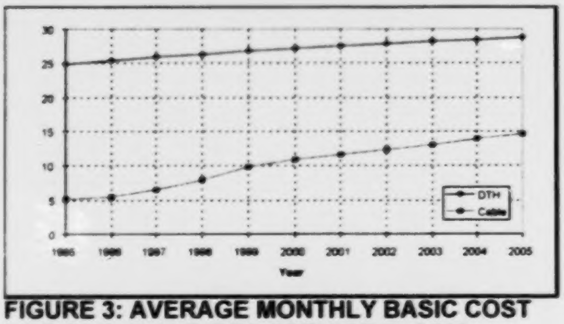

FIGURE 3: AVERAGE MONTHLY BASIC COST FOR CABLE AND DBS SERVICE IN ASIA

DTH provides an excellent example of how technological development can change the evolutionary path of telecommunication services between regions. The demand for higher quality TV reception and additional channel selections resulted in cable TV access being provided to 97% of all households in the US, at a huge cost, in the 1970s and 1980s. At that time, DTH was not a cost effective service delivery option. Today, however, DTH is a very attractive alternative to cable TV because technological advances in satellites and set-top boxes have made it more affordable. In regions with little cable infrastructure, DTH is expected to be the dominant source for TV. In Eastern Asia and South America, DTH is already ahead of cable in terms of market penetration.

The industrial regions, especially North America, accounted for most of the initial global growth in very small aperture antennas (VSATs), mobile phone, and cellular service growth. In contrast, the developing regions are expected to be the primary market for the latest satellite-based regional mobile and fixed wireless phone systems, and the satellite-based broadband network services which will be introduced in the next several years.

One-way and interactive VSAT network sites in the Asia-Pacific region increased from 5,000 to about 21,000 between 1992 and 1994 (48% of them in Japan). China's share of the region's VSAT sites is expected to grow significantly from 12% in 1994 to 30-40% in 1997, and 50-60% by 2005. Industry analysts predict that the region's installed base will reach 95,000 terminals by 2000 and 175,000 terminals by 2005 (12).

Since the late 1980s, mobile telecommunications markets have been extremely dynamic in the Asia-Pacific region. The 13 largest cellular markets in the region more than tripled their total cellular telephone subscribers from 1990 to 1994. This significant increase in cellular subscribers (from 1.54 to 9.05 million) corresponded to a compound annual growth rate of 56% (12).

Many low-income countries in the Asia-Pacific region use cellular telephones and pagers as overlay or bypass systems because of the low density and other limitations of the existing fixed networks. The more developed countries (e.g., Singapore, Hong Kong, Taiwan, and Australia) in the region are achieving cellular penetration rates well above the regional average. Regular price decreases are also occurring now due to rapid competition developing among cellular operators in almost every Asian country. In addition, the region is moving from analog to GSM or code division multiple access (CDMA) technologies to provide for the increasing subscriber demand (12).

Forecasts, published to the year 2000, of the Asia-Pacific cellular telephone market estimate a range from 19.5 to 37.5 million subscribers. These dynamic cellular markets coupled with the geographic characteristics and low teledensity of many Asian-Pacific countries make the region an attractive market for mobile communications satellite operators (12).

3. ADVANTAGES OF SPACE-BASED SYSTEMS

The major advantages offered by the new space-based telecommunications systems are coverage, usage cost, time-to-market, and services flexibility.

3.1 COVERAGE

Space-based telecommunications solutions offer a major advantage over terrestrial networks on both a regional and global scale. Specifically, satellites in GEO orbit have been deployed commercially since 1965 for wide area communications. Depending on the application and communications link requirements, a single GEO satellite can effectively provide coverage to one-third of the earth between the latitudes of +/-70 degrees. This provides the capability to communicate from any point to any other point within the coverage area using remote terminals creating a major advantage in areas where terrestrial communications infrastructure does not exist.

For mobile and fixed telephony, this coverage advantage means that a single MWS/FWS satellite could replace the equivalent of hundreds of cellular base stations or thousands of square miles of wireline infrastructure. In regions of the world where it is impractical to install terrestrial infrastructure due to distributed land masses (e.g., the islands of Indonesia) or rough terrain (e.g., the Himalayan mountains in Nepal and Tibet), satellite-based MWS/FWS provides an ideal solution.

For video broadcast systems, the satellite coverage advantage allows single or multi-source programming to be delivered to a broad coverage area normally covered by hundreds of local terrestrial broadcast stations. This capability enables greater market access and revenue potential. The one major limitation of DBS systems is they do not have sufficient capacity to offer local content in all of the markets they serve. However, this limitation is rapidly disappearing as the available spectrum is being used more efficiently with advancements in technology such as an increased number of transponders per satellite, improved digital compression, and spot beam capability.

The coverage advantage inherent in FSS and BBS is that regional and global connectivity is provided for distributed intranet users (e.g., multi-national corporations) with multiple network nodes, which ultimately translates to higher reliability and reduced congestion. The ability of satellite-based systems to bypass the terrestrial network will be a key discriminator for businesses with time-critical data communications requirements and offices in non-industrialized regions. In many of these areas, terrestrial network availability can be intermittent and service outages can last for days.

3.2 USAGE COSTS

Space-based telecommunications systems, particularly GEO systems, provide a lower cost solution in almost all cases where telecommunications infrastructure does not already exist, or only partially exists. There are multiple dimensions to cost for each major product area consisting of both installation and usage costs. However, two facts are true for all satellite telecommunications. First, the cost of transmitting information via satellite is essentially independent of distance. Second, the large coverage area and bandwidth provided by a single satellite gives it a huge potential subscriber base. Even at initial penetration, the satellite system can begin to make a profit for the operator in the local markets it serves.

3.2.1 MOBILE/FIXED WIRELESS SYSTEMS (MWS/FWS)

For MWS/FWS that supply voice and narrowband data applications, the primary cost parameters to be considered are installation cost per subscriber and usage cost per minute. Table 3 compares these parameters for different transmission systems (1,4). This shows that the GEO satellite system clearly provides the best solution for wide-area coverage and difficult terrain. GEO satellite systems may also be the best choice for smaller areas where infrastructure does not yet exist.

TABLE 3: MWS/FWS VS. WIRELINE COST COMPARISON FOR REGIONAL SERVICE

Factors	Terrestrial Systems	Global LEO / MEO Satellites	Regional GEO Satellites
Installation Cost ($/VEC)	10 X Regional GEO (to wire new regions)	10 - 20 X Regional GEO (to achieve regional concentration)	$25,000 - $40,000
Maintenance Cost ($ / VEC)	Medium	High	Low
Retail Subscriber Usage Cost	$0.35 - 1.00 / min	$1 - 3 / min	$0.35 - 1.00 / min
Capacity over Region	Limited by population density, terrain & capital	Low to Medium	High (relative to global LEO/MEO systems)
Voice Delay	0.1 - 0.15 sec	0.1 - 0.15 sec	0.24 - 0.27 sec

VEC = Voice equivalent circuit

3.2.2 DIRECT BROADCAST SYSTEMS

The primary cost measurement evaluated for DBS systems is monthly cost per channel. With compression technology being equivalent for both space-based and terrestrial systems, this measurement translates into available bandwidth or number of transponders on-board the satellite for a given cost. Improvements in spacecraft bus technology have enabled satellite broadcast systems to become extremely competitive with cable broadcast systems in some parts of the world. The price of a DBS antenna and decoder has dropped from about $700 to below $200 in the US over the last three years, and in some markets they will be given away for free in an attempt to gain market share. The monthly subscription cost ranges from $6 to $35, depending on the premium channel selection, which is essentially the same as that for cable TV.

DBS service provides an excellent example of the cost advantage provided by space-based systems in regions with limited telecommunications infrastructure. The cost to establish a representative U.S.-based DTH system is approximately $750 million. Now consider that the global average of the cost to install a new main phone line is $1,500 per line. The cost to install cable TV is somewhat less because it does not require the local exchange switch associated with a phone line. If the average cost to install cable TV is $750 per home (one-half the cost of a phone line), the $750 million used to launch the DTH system (providing service to the entire continental U.S.) would have only been able to wire about one million homes for cable TV. Even if the subscriber antenna and set-top box are sold at a loss by the DTH service provider, a DTH system is still often cheaper than laying cable.

3.2.3 BROADBAND SYSTEMS

The price of available bandwidth (or cost per bit) is the key cost measurement for broadband systems. As with DBS, improvements in satellite technology have enabled satellites to provide more economical solutions than terrestrial systems in recent years. More available power on-board has resulted in more radiated power from the satellite and added functionality such as digital signal processing (DSP). DSP technologies reduce the RF uplink signal to a bit stream, or a packet, and route it to the appropriate user downlink beam. This results in a reduction in data overhead and allows more user-to-user data circuits (packets) to be compressed into the available bandwidth allocated to the satellite. Also, with the availability of the Ka-band spectrum soon to be licensed by the FCC and ITU for global communications, smaller spot beams from on-board antennas will allow more efficient frequency re-use across a given coverage region.

All of these near-term improvements will drive the cost per bit down even further, allowing satellites to compete even more favorably with terrestrial systems. This is illustrated in Figure 4 which compares the cost per T1 minute of several planned BBS systems to current terrestrial leased line costs (1,10).

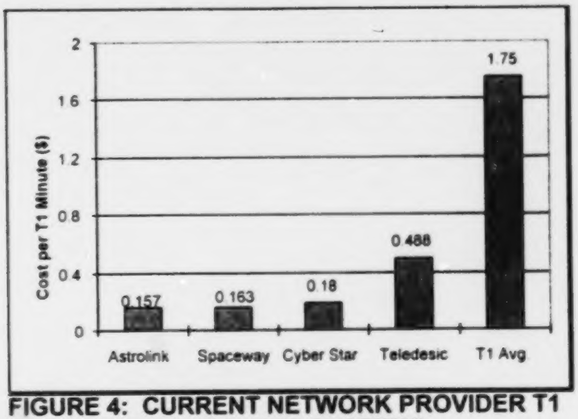

FIGURE 4: CURRENT NETWORK PROVIDER T1 COST VS. PLANNED BBS SYSTEMS

Table 4, which compares usage costs for equivalent terrestrial leased line circuits over varying distances, illustrates how satellites offer a clear cost advantage at medium to long distances (1,7). This is especially true for international networks, where the cost for the international connection alone exceeds the BBS system usage cost.

TABLE 4: CURRENT NETWORK PROVIDER LEASED LINE VS. BBS USAGE COST COMPARISON FOR 54 KBPS

Distance (km)	Terrestrial Leased Line Cost	BBS Usage Cost ($/min)
25	0.03	0.10
100	0.07	0.10
500	0.21	0.10
The following are costs for international leased lines, which are in addition to source and destination country line charges		
US - UK	0.16	0.0
US - Greece	0.26	0.0
US - Japan	0.29	0.0

3.3 TIME-TO-MARKET

Given that a typical communications satellite takes 18 to 30 months to deliver on-orbit, space-based systems have a clear advantage over terrestrial systems (e.g., wireline, cable, fiber, and microwave) in regions where such services do not already exist. Another advantage of a satellite system is that once the system is in place, additional subscribers within the coverage region can be added by the service provider immediately at no additional systems cost (except for terminals) because no additional infrastructure is required.

3.4 SERVICES FLEXIBILITY

New technologies and designs are rapidly making satellite-based telecommunications systems highly reconfigurable. In the past, almost every satellite was optimally designed to provide a specific service for a predefined coverage area (e.g., FSS for Australia, DBS for China). Once the satellite was launched, neither the type of service it provided nor its coverage area could be changed. If the revenues generated from the satellite underperformed for any reason, the satellite operator would experience a reduced return on investment (ROI) with no ability to change coverage patterns. However, with the advent of new technologies such as active array antennas, digital beamformers, and digital signal processors, satellite operators will soon be able to change coverage patterns (and even service types) after the satellite is in orbit thereby maximizing the system's revenue and reducing business risk. These technologies are discussed in detail in section 4.3.

4. FUTURE TECHNOLOGY ASSESSMENT

In order to further improve the advantages provided by satellite telecommunications systems today, companies must make focused investments in technology which will increase the revenue earning capacity of their systems. The major areas of technology development which increase the market advantage of space-based telecommunications systems are higher capacity spacecraft platforms, higher capacity launch systems, and reconfigurable payloads.

4.1 HIGHER CAPACITY SPACECRAFT PLATFORMS

The payload capability of communications spacecraft has steadily increased in the last decade and is expected to increase dramatically over the next five years. By 2002, the payload power capability is projected to increase by a factor of three (from 6kW to 16kW).

The technologies supporting the rapid increase in power are larger solar arrays with high efficiency silicon, gallium arsenide (GaAs) and multi-junction solar cells; high capacity nickel hydrogen (NiH_2) battery technology, and high capacity power regulation units. Lithium ion batteries will provide even higher energy storage capacity for a given battery mass (90W to 150W-hours per kg vs. 45W to 60W-hours per kg for NiH_2) on future spacecraft. In conjunction with the increased payload power capability, advances in lightweight materials, advanced thermal control, and high efficiency propulsion have increased the spacecraft payload mass capability for a given launch mass. Graphite epoxy and metal matrix composite structural elements and mechanisms have enabled a 25% weight reduction in the overall spacecraft structure vs. traditional aluminum structures. In conjunction with the weight reduction, stronger advanced materials also support increased loading required for multiple launch vehicle compatibility, and higher overall structure size and launch mass to support larger payloads.

Advanced thermal technologies such as deployed radiators with flexible heat pipes and capillary pumped loops enable spacecraft to accommodate higher thermal dissipation over the same payload mounting area. This allows increased packaging density of high dissipating payload components (such as solid state power amplifiers and traveling wave tube amplifiers) to maintain an overall structure size that can fit within available launch vehicles while increasing payload output power.

Advances in propulsion technology such as high performance liquid apogee engines (LAEs), Hall-current thrusters (HCTs) and ion thrusters will also have a dramatic impact on the payload capability of the spacecraft. Over two-thirds of the spacecraft propellant at launch is used to boost the spacecraft from transfer orbit to geosynchronous orbit. Improving the specific impulse of the LAE enables a large reduction of overall launch mass, or an increase in payload mass/capacity for a given orbit lifetime.

HCTs and ion thrusters can be used for stationkeeping and also to supplement the transfer orbit of the spacecraft. HCTs use high energy electrons to ionize xenon gas and create a charged plasma to develop thrust. With specific impulses ranging from 1,300 to 3,500 sec. vs. typical bi-propellant thrusters at 300 sec and arcjet thrusters at 600 sec., HCTs can save over 800 kg of propellant for a 4,000 kg class satellite when used for stationkeeping and transfer orbit boost. Once again, this savings can be translated into reduced launch mass and cost, or to increased revenue earning payload capacity on-board the spacecraft.

4.2 LAUNCH SYSTEM CAPACITY INCREASE

With spacecraft sizes increasing at such a rapid pace, significant pressure has been placed on the launch vehicle providers to increase their lift capability at a similar rate. However, evaluating the current and planned commercial launch vehicles for the next five years reveals a limitation in these vehicles. Only Proton and Ariane can lift satellites with launch masses above 5,000 kg into the required geosynchronous transfer orbit (GTO). With the desire of operators to place as much revenue earning capacity on orbit as possible with each asset launched, this may become the limiting factor in the growth of communications spacecraft platforms. Looking beyond five years, future launch vehicles such as the EELV (11,000 kg to GTO) and RLV (8,400 kg to GTO) programs will provide another surge in available lift capability.

4.3 RECONFIGURABLE PAYLOADS

With the advent of larger spacecraft platform capability, the functionality and flexibility of the payload can be increased in other ways besides just increasing the number of transponders. Technologies such as active array antennas, digital beamformers and digital signal processors that were once too power and mass intensive for earlier spacecraft platforms are now realizable through improvements in device technology and the growth in bus capability. This evolution in spacecraft and payload technology is depicted in Figure 5. The increased capability provided by incorporating these technologies into future spacecraft will dramatically change the way communications satellites are deployed and operated.

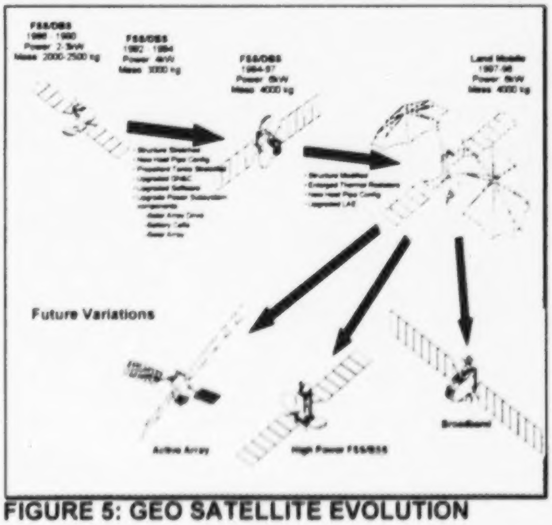

FIGURE 5: GEO SATELLITE EVOLUTION

4.3.1 ACTIVE ARRAY ANTENNAS

Active Array antennas have the capability to shape and electronically steer multiple beams anywhere within the satellite's field of view by changing the phase and amplitude weightings of each individual element within the array. With this capability, operators will be able to:

- Reconfigure coverage patterns with changing market demand to capture otherwise lost revenues
- Periodically reconfigure the beam pattern(s) to track the peak demand for services across a region
- Provide a universal spare for a fleet of satellites with different coverage patterns
- Create multiple isolated beams within a coverage region to allow for multiple re-use of the same frequency
- Defer configuration of the payload until later in the program or on-orbit to reduce business plan risk
- Provide surge capacity to crisis users such as the government, military, or news agencies

4.3.2 DIGITAL SIGNAL PROCESSING

DSP allows an RF signal to be digitized and routed at a packet or circuit level from one user beam to another user beam within the coverage region. It can also be used to provide beam reconfiguration, similar to an active array, by digitally weighting the phase and amplitude of each antenna element. Figure 6 compares conventional and DSP payload block diagrams. DSP technology integrates many functions into a single unit, resulting in an overall decrease in the number of components and increases in system reliability. DSP also provides increased isolation between uplink and downlink signals which yields improved link margins.

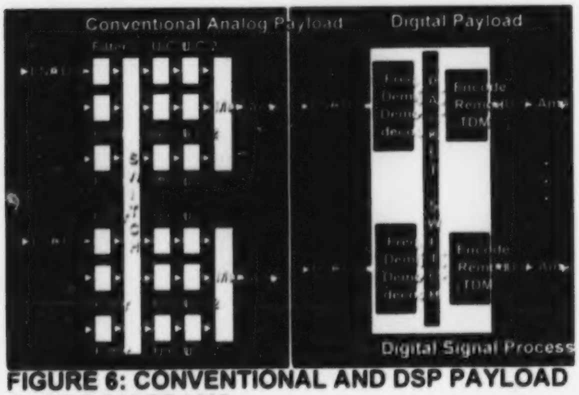

FIGURE 6: CONVENTIONAL AND DSP PAYLOAD BLOCK DIAGRAMS

DSP technology has improved dramatically over the last several years. The improvements allow more functionality and throughput to be packaged on component boards for a given power and mass envelope. Table 5 shows the DSP capability improving for past and future satellite missions.

TABLE 5: PAST AND PROJECTED DSP CAPABILITIES

Program /Hardware	Year Began	Ops/ Sec (B)	DSP Functions
ACTS	1993	0.11	TDMA Processing
Digital Channelizer	1998	240	TDM / Circuit Switching, Channelization
Digital Beamformer	1999	800	TDMA Processing, Channelization, Beamforming
Broadband DSP	2000	3900	Channelization, Demod, Decode, Fast Packet Switching, Encode, Modulation, Resource Control

4.3.3 FREQUENCY AGILITY

Using programmable synthesizers and filters for receivers, upconverters, downconverters, and multiplexers, payload frequency plans can be reconfigured on-orbit to provide flexibility for addressing new market requirements. Within a given band (e.g., Ku-band) there are multiple sub-bands allocated for DBS and FSS in varying regions of the world. Reconfigurability, especially to other service segments (e.g., DBS to FSS), greatly reduces the business risk associated with a satellite-based system. If the planned service turns out to be unprofitable, the satellite can be reconfigured and deployed in another venture.

5.0 FUTURE MARKET ASSESSMENT

Space-based telecommunications systems are well positioned to capture a large portion of the expanding telecommunications services industry. In general, the largest FSS/BBS markets are projected to be in the industrialized regions where there is an increasing demand for high-speed, multi-media services and internet/intranet access. In addition, FSS/BBS systems have an opportunity to provide solutions for reliable worldwide enterprise networks

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of multinational corporations in emerging and developing regions.

The largest DBS and MSS markets are expected to be in the developing regions, such as Asia and the Pacific Rim, where the ability of these systems to rapidly and inexpensively provide basic television and mobile and fixed wireless telephony gives them a significant economic advantage over terrestrial systems. The use of DBS systems is also expected to increase in industrialized regions because DBS can deliver a competitively priced high quality alternative to areas where cable TV previously had a monopoly.

Future technological advances such as higher capacity platforms, active array antennas, reconfigurable payloads, digital signal processing, frequency agility, and launch systems capacity increases are achievable in the next three to five years. They will provide a major impact to space-based telecommunications systems in terms of reduced cost per voice circuit for mobile and fixed wireless systems, reduced cost per transponder for DBS and FSS systems, and reduced cost per bit for broadband systems ultimately providing increased flexibility in business planning.

The new generation of flexible and reconfigurable satellite systems are well positioned to offer both basic and value-added services, particularly to Asian-Pacific customers, well into the next century. The ability of space system suppliers to capture future market share in the expanding telecommunications market will be directly related to how aggressively they pursue these opportunities.

REFERENCES

1. Lockheed Martin Telecommunications
2. International Telecommunications Union, "World Telecommunication Development Report, World Telecommunications Indicators," March 1997.
3. Bear Sterns Equity Research, "Satellite Communications," November 5, 1996.
4. Smith Barney, "Initiating Coverage of the Satellite-Based Communications Industry," October 1995.
5. Pyramid Research, Inc., "Telecommunications Markets in South America," Cambridge, MA, October 1996
6. North American Telecommunications Association, "1995 Telecommunications Market Review and Forecast," 1995.
7. ITU Web Site , "Tariffs for International Leased Lines"
8. Gordon, G.D. and Morgan, M. L., Principles of Communications Satellites, John & Sons, New York, NY, 1993.
9. Schirmann, Savely, "Commercial Geostationary Satellites: A World Market Forecast 1993 - 2007," Satel Conseil, Montrouge, France, May 1993.
10. Hastings, Daniel, Kelic, Andjelka, Shaw, Graham, "Comparative Study of the Astrolink, CyberStar, Spaceway, Teledesic and VoiceSpan Satellite Communications Systems Using a Cost per T1 Minute," Space Systems Laboratory, Department of Aeronautics and Astronautics, Massachusetts Institute of Technology, January 6, 1997.
11. Kagan World Media, "Kagan's Asia-Pacific Cable/Pay TV," April 1996.
12. Euroconsult, "Asia-Pacific Satellite Communications and Broadcasting Market Opportunities," Paris, June 1995.

Crowded Skies

Is There Room For More Satellites Over The Asia-Pacific?

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1. ABSTRACT

Since the late 1980s, the rate at which geosynchronous satellites have been launched has exceeded the rate at which saturation of the orbital arc would be achieved. This has been especially true of the Asia-Pacific. The skies are already too crowded. Complicating this crowding issue has been a trend toward ever decreasing antenna sizes.

1. SATELLITE SPACING OVERVIEW

From 1965 to 1972 there was only one commercial satellite communications organization: Intelsat. The United States military forces had communications satellites, but they used different frequencies. The USSR had communications satellites in "Molniya" orbits. There was little or no need to "coordinate" with other satellite systems. Beginning with Canada's Anik satellites in 1972, domestic satellites quickly overtook Intelsat in numbers--and they used the same orbits and the same frequencies. By 1974 the United States had also launched it first domestic satellites. Indonesia launched its first satellite in 1976.

By the late 1970s there were four organizations operating communications satellites over North America: Telesat Canada, Western Union, RCA, and AT&T partnered with COMSAT. Each wanted at least three satellite "slots." The main North American land mass extends between roughly 70W to 125W--about 55 degrees of longitude. This was not quite enough to provide 5 degree spacing, especially given the advantage of the central slots or perhaps those a little West of the midpoint. A compromise spacing of 4 degrees was adopted. The 100th meridian was famous in US history, but it also marked the most desirable "slot." This desirability was enhanced by the closeness of the "stable point." A location (105W) where the East-West acceleration on a satellite due to the earth's triaxiality is near zero. Indonesia carefully placed its first satellites at 108E, 113E, and 118E--all 5 degrees apart.

As more and more North American satellites were launched, they were place closer and closer to each other. The FCC in 1983 established a long-term goal of 2 degree spacing. This was implemented in 1993. There were several problems--especially with thin route and VSAT networks--but most operators successfully adapted to the rule.

With increasing affluence and increasing needs for entertainment and business communications, the problems which had afflicted North America rapidly became problems over the Asia-Pacific--but without the guidance of an FCC.

2. PROBLEMS OVER THE ASIA-PACIFIC

Starting in the 1990s, many satellites have been planned and launched over the Asia-Pacific. A variety of problems have arisen including: (1)

paper congestion at the ITU caused by excessive filing, (2) satellite congestion in space, and (3) the growing tendency to ignore ITU rules. The new "crowded skies" require increased cooperation among regional administrations at the very time when competitive factors seem to be reducing this cooperation. New frequency bands must be exploited and the old ones must be cooperatively used to prevent excessive interference.

2.1 PAPER SATELLITES

If we assume that satellites are located every 2 degrees around the globe, and further assume that they are all hybrid C-/Ku-band satellites with overlapping coverage, a maximum of 180 geosynchronous satellites can be placed in orbit around the globe. There are currently over 170 in orbit. The present trend in satellite lifetimes is about 15 years. Failure rates are about 15%. The saturation replacement rate can be calculated using this information--it is about 14 satellites per year. The launch rate since the late 1980s has averaged more than 20 satellites per year.

Given the saturation or approaching saturation of the geosynchronous arc, many operators/countries filed for more satellite networks than they could reasonably expect to launch in the immediate future in order to ensure that some orbital slots would be available when they actually began to implement their networks. In 1979 there were 25 ITU satellite filings for orbital slots. By the early 1990s, filings had reached 100 per year--greatly exceeding any likely replacement rate by a factor of seven to ten. Recent filings have exceeded 500 per year and show little sign of diminishing. During 1997 there were more than 1000 filings. This has caused an unreasonable glut of paperwork which exceed the ability of the ITU to process filings in a timely fashion. This global problem has also been encountered by individual administrations who have also been inundated with these filings. Most of these satellites will never fly--there is not sufficient orbit/spectrum resource.

2.2 ORBITAL CONGESTION

When Indonesia put its first Palapa satellites in orbit in 1976, it was reasonable to expect that 5 degree spacing would remain the norm. This is no longer the case. Within the next year, the original Palapa locations will have satellites in adjacent orbital slots within 2 degrees to 3 degrees. There are satellites expected to be launched within the next two years into 120E, 121E, 122E, 123E, 124E, and 125E. These satellites will have difficulty operating with the large amounts of adjacent satellite interference. Newcomers are filing for clearly inappropriate orbital slots in the hope that by the time they launch some accommodation can be made.

2.3 SCOFFLAWS

Perhaps of greatest concern are the number of operators and administrations who follow neither the letter nor the spirit of the ITU rules and regulations. Instances of satellites launched without coordination and of jamming are becoming frequent, if not commonplace. Systems are planned which are clearly incompatible with neighbors in the clear hope of scaring off the law-abiding operators with bullying tactics.

A problem which has some law-abiding operators/administrations acting outside of the spirit of the ITU rules and regulations is the use of FSS bands for Direct-to-home (DTH) transmission. DTH marketing seems to require excessively small dishes (45 cm) which tend to "sterilize" a part of the orbital arc. This is discussed in somewhat more detail below.

The tables below shows the differential gain in dB with 2 degree spacing:

	4GHz	6GHz	12GHz	14GHz
Ant (m)	ΔG	ΔG	ΔG	ΔG
0.4	0.3	0.6	2.6	3.5
0.6	0.6	1.4	5.8	7.8
0.8	1.1	2.6	10.2	13.9
1.0	1.8	4.0	14.1	14.4
1.2	2.6	5.8	14.5	**21.6**
1.4	3.5	7.8	**21.6**	**22.9**
1.6	4.6	10.2	**22.7**	**24.1**
1.8	5.8	13.0	**23.7**	**25.1**
2.0	7.1	14.1	**24.7**	**26.0**
2.2	8.6	14.3	**25.5**	**26.8**
2.4	10.2	14.5	**26.2**	**27.6**
2.6	12.0	**20.9**	**26.9**	**28.3**
2.8	13.9	**21.6**	**27.6**	**28.9**
3.0	14.1	**22.2**	**28.2**	**29.5**
3.2	14.2	**22.7**		
3.4	14.4	**23.2**		
3.6	14.5	**23.7**		

In general, the 14 dB differential gain criterion is met by the first sidelobe, but the 20 dB criterion is not met until beyond the first sidelobe. The ability of a small antenna to operate in this crowded spacing is primarily dependent on the difference between the maximum gain and the gain of the first sidelobe. Many small antennas are designed such that the first sidelobe is reduced to the 29-25logΘ level at transmit frequencies. Performance at receive frequencies is often worse--typically 32-25logΘ.

3.2 EIRP: HOMOGENEOUS SATELLITES

Non-homogeneous satellites can cause problems because the higher-powered satellite imposes antenna size constraints (due to C/I) on the lower-powered satellite. Beyond a certain EIRP level (about 39-42 dBw) there is no real advantage to increasing EIRP as the link budget is dominated by C/I. Homogeneous satellites are easier to coordinate and should be at a specific agreed-upon EIRP level.

4. TWO-DEGREE SPACING IN THE UNITED STATES

In 1983, the U.S. Federal Communications Commission (FCC), noting the large number of applicants for orbital slots, determined that 2 degree spacing was the most equitable and efficient method of allocating orbital slots. Fortunately, it was not necessary to fully implement this allocation for ten years, but operators were aware of the coming regime.

As part of its final ruling, the FCC amended Part 25 to define a new antenna standard. This improved the sidelobe standard from the then-

2.4 INEFFICIENT USE OF THE ORBIT/SPECTRUM RESOURCE.

While many satellites today are launched with 24 C-band and 24 Ku-band transponders, there are still satellites in orbit with no usable transponders, or three, or six, or twelve. These satellites occupy an orbital slot which could be used far more efficiently. In some cases, the increasing cost of launching a satellite has meant that minimizing cost per transponder has become imperative. Econmics may solve this problem.

3. SATELLITE EIRP AND EARTH STATION ANTENNA SIZE

Interference from adjacent satellites is becoming the limiting factor in link budgets. Earth station antenna size generally decreases with increasing satellite power (EIRP). However, it can be the case that increasing EIRP does not increase the communications power to noise plus interference power [C/(N+I)] because, with homogeneous satellites, I increases at the same rate as C. Thermal noise is a minor contributor in a link budget dominated by adjacent satellite interference.

3.1 EARTH STATION ANTENNA SIZE AND ITS EFFECT ON C/I

The ultimate constraint on satellite spacing is the ability of earth station antennas to discriminate between desired and undesired signals--to reduce adjacent satellite interference. The differential gain--the difference between on-axis and off-axis gain--is somewhat arbitrary, but in general should be at least 14 dB and preferably 20 dB for digital signals. This assumes that the adjacent satellite is similar in power and coverage (i.e., homogeneous). Antennas as small as 1.8 meter in C-band and 45 cm in Ku-band are currently in use. These antennas are clearly too small. There is a desire to use the smallest possible antennas--in part because of the aesthetics and ease of installation rather than just the cost.

The formulas below allow us to calculate the differential gain at various frequencies for various size antennas. This differential gain is approximately equal to the single entry C/I calculated for adjacent homogeneous systems.

G_{max}	$= 10 \log [\, eff.(\pi * D/\lambda)^2]$	Maximum on-axis gain
Θ_{3dB}	$= (65^{\circ})\, \lambda/D$	3dB beamwidth
Θ_{10dB}	$= (112^{\circ})\, \lambda/D$	10dB beamwidth
G_1	$= 2+15\log (D/\lambda)$	Gain of first sidelobe
Θ_m	$= 20\lambda/D\, (G_{max} - G_1)^{0.5}$	Angle to first sidelobe (start)
Θ_r	$= 15.85\, (D/\lambda)^{-0.6}$	

$G(\Theta)$	$= G_{max} - 2.5\times10^{-3}\, (D\Theta/\lambda)^2$	$0 < \Theta < \Theta_m$
	$= G1$	$\Theta_m < \Theta < 100\, \lambda/D \quad (D/\lambda < 100)$
	$= 29 - 25 \log \Theta$	$100\, \lambda/D < \Theta$

Note: D is the diameter of the antenna reflector.
λ is the wavelength of the carrier.
Θ is the agle from the axis.

current 32-25logΘ (ITU-R 465) to 29-25logΘ (ITU-R 580)--but only in the plane of the GEO orbit. In addition, a polarization standard was approved that was designed with analog TV in mind.

There are several items that should be noted about this ruling: (1) it forced operators to move satellites, (2) it imposed a new antenna specification, (3) it allotted orbital slots, (4) it advocated homogeneous satellites, (5) it did not set C/N requirements, but effectively set C/I requirements by establishing Eb/Io requirements, and (6) it recognized that there were limited orbital slots and preferred orbital slots.

Experience with this regime has been mixed, but generally good. Analog TV transmissions were well protected from each other. VSAT SCPC carriers had to avoid transponder centers and transponder edges to avoid interference from TV signals. C-band VSAT antennas needed to be 2.4 meters or larger and offset-fed to reduce sidelobes. Ku-band VSAT antennas needed to be 1.0 meter or larger.

5. THE ITU AND RESOLUTION 18

Resolution 18 of the 1994 Kyoto Plenipotentiary Conference of the ITU recommended a review of international satellite network coordination and planning. The problems noted were those discussed in 2. above. Three major solutions were proposed: (1) "due diligence," (2) modification of the filing and coordination processes (number of filings, timing, coordination arc), and (3) insistence on best technical practice.

The ITU is relatively conservative in its approach to these issues. There are always many points of view on any question. There does seem to be significant support for many of the proposed solutions because most administrations are affected by the problems.

There remains one major problem. The ITU has no enforcement mechanism. The administrations are meant to enforce the rules and regulations. As the administrations are usually the culprits or accomplices of the culprits the question *"who shall guard the guards"* is obvious.

6. RECOMMENDATIONS

There is a need for a regional organization backed by the major nations of the Asia-Pacific, especially East Asia, and especially the major satellite operators who would gather together to agree on, and then enforce through coordination and public reprimands, a set of standards for the region. These standards should be the ITU standards with the addition of requirements similar to those impose by the FCC on American operators: spacing, homogeneous EIRP/SFD, low sidelobes, good cross-pol protection, and others as seen necessary. These might include:

a) spacecraft:

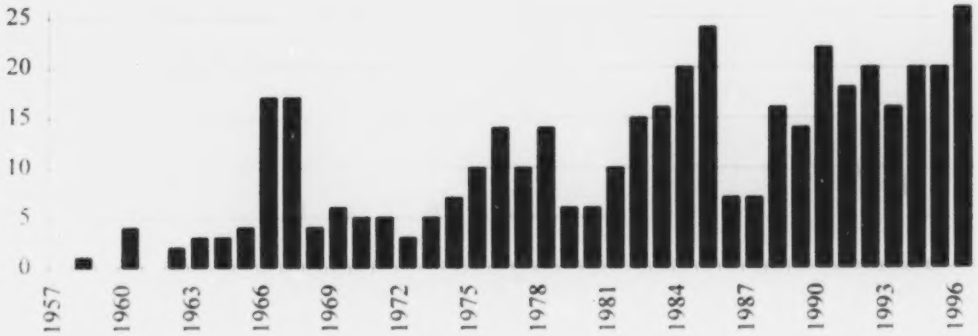
Maximum EIRP	41 dBw (C-band), 54 dBw (Ku-band)
Orbital Spacing	2 degrees
Maximum Downlink PSD	-34 dBw/Hz

b) earth station

Sidelobes	29-25logΘ including first sidelobe
Cross-Polarization Isolation	30 dB at -1 dB contour
Minimum antenna size	2.4m (C-band), 0.8m (Ku-band)
Maximum Uplink PSD	-39 dBw/Hz

Without these agreements on the regional level, coordination is based on bilateral negotiations in which the administration/operator with the most clout can impose solutions on the other party. Several proposals are currently being considered to implement multilateral coordination meetings. The United States, Canada, and Mexico have entered into a trilateral coordination agreement which has simplified coordination in North America. A similar arrangement in Asia will be more difficult because there are far more than three administrations (governments)--but the benefits greatly outweigh the problems..

Communications Satellite Launch Rate (1957-1996)



Geostationary Orbit Filings (January 1997)

ADM	SATELLITE NAME	LONG	S	ADVPUB	ASEC	RC/PUB	CSEC
CHN	CHINASAT-22	98.00 E	A	28/06/94	1108		
CHN	CHINASAT-3	98.00 E	N	17/12/85	257	16/06/87	1039
SNG	ST-1B	98.50 E	A	16/01/96	891		
SNG	ST-1B	98.50 E	A	07/05/96	891		
SNG	ST-1B	98.50 E	C	09/02/93	891	14/12/93	2370
SNG	ST-1B	98.50 E	C	09/02/93	891	10/09/96	2370
SNG	ST-2B	98.50 E	A	05/11/96	1834		
RUS	EXPRESS-13	99.00 E	C	19/11/91	769	22/06/93	2304
URS	STATSIONAR-T	99.00 E	N	01/06/76	2		
URS	STATSIONAR-T2	99.00 E	N	08/07/80	10	19/05/81	7
USA	USASAT-32X	99.00 E	A	16/07/96	1658		
IND	INSAT-ES100	100.00 E	A	30/04/96	1538		
IND	INSAT-KA100	100.00 E	A	30/04/96	1552		
MEX	MEGASAT-8	100.00 E	A	20/08/96	1688		
G	ASIASAT-DBA 2	100.50 E	C	10/05/94	1066	24/09/96	2559
G	**ASIASAT-E**	**100.50 E**	**C**	**05/11/91**	**750**	**10/03/92**	**2110**
G	**ASIASAT-EK1**	**100.50 E**	**C**	**17/12/91**	**783**	**20/10/92**	**2236**
G	ASIASAT-EKA	100.50 E	A	10/09/96	1727		
G	ASIASAT-EKS	100.50 E	A	14/03/95	1233		
G	ASIASAT-EKX	100.50 E	A	12/09/95	1337		
PAK	PAKSAT-E	101.00 E	A	21/05/96	1583		
PAK	PAKSAT-HDTV-E	101.00 E	A	03/12/96	1851		
THA	THAICOM-A1	101.00 E	C	04/06/91	710	21/07/92	2184
THA	THAICOM-A1KA	101.00 E	A	14/01/97	1888		
THA	THAICOM-AK1	101.00 E	C	04/06/91	710	11/08/92	2195
USA	USASAT-32Y	101.00 E	A	16/07/96	1659		
CHN	CHINASAT-11	101.50 E	C	17/12/91	777	25/06/96	2516
CHN	CHINASAT-45	101.50 E	A	17/09/96	1732		
CHN	DFH-4-OC	101.50 E	A	25/02/97	1915		
G	SKYSAT-C3	101.50 E	A	06/02/96	1243		
G	SKYSAT-C3	101.50 E	C	21/03/95	1243	17/12/96	2623
G	SKYSAT-C3	101.50 E	C	06/02/96	1243	17/12/96	2623
CHN	CHINASAT-21	103.00 E	A	28/06/94	1107		
CHN	DFH-3-0B	103.00 E	N	08/11/88	469	02/07/91	1955
CHN	DFH-4-OB	103.00 E	A	25/02/97	1914		
CHN	STW-2	103.00 E	N	29/10/85	245	09/06/87	1023
IND	INSAT-EK103	103.00 E	A	23/04/96	1524		
IND	INSAT-EK103R	103.00 E	A	23/04/96	1531		
IND	INSAT-X103	103.00 E	A	30/04/96	1560		
KOR	INFOSAT-A	103.00 E	A	13/02/96	1419		
LAO	L-STAR2	103.00 E	A	28/05/96	1585		
RUS	EXPRESS-9	103.00 E	C	19/11/91	765	22/06/93	2300
RUS	VOLNA-103E	103.00 E	C	02/06/92	817	23/11/93	2361
URS	LOUTCH-5	103.00 E	N	22/10/85	243	24/03/87	966
URS	**STATSIONAR-21**	**103.00 E**	**N**	**22/10/85**	**244**	**11/11/86**	**905**
URS	STATSIONAR-21	103.00 E	C	22/10/85	244	13/02/90	905

Satellite Strategies and Policies: Lessons from the Asia-Pacific Region

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Abstract

Asia's vast land area, its population of more than 3 billion, a teledensity of fewer than 3 lines per 100 inhabitants in the lower income countries, and its unserved rural areas and isolated islands of South East Asia and the Pacific, all make the Asia-Pacific region attractive for satellite communications.

Yet not all of the potential customers in the region may benefit from the current proliferation of satellites, as restrictive policies and lack of terrestrial infrastructure may preclude access to new satellite services. This paper examines the issues surrounding the increase in satellite capacity serving the developing countries and emerging economies of the Asia-Pacific region, and derives lessons from the Asia-Pacific's satellite experience.

1. The World's Largest Satellite Market

Asia's vast land area, its population of more than 3 billion, a teledensity of fewer than 3 lines per 100 inhabitants in the lower income countries, and its unserved rural areas and isolated islands of South East Asia and the Pacific, all make the Asia-Pacific region attractive for satellite communications. Indeed, the Asia-Pacific region now lags only North America in number of commercial satellites in orbit, and leads the world in the number of satellites on order.[1]

The race to add capacity involves international systems such as Intelsat and PanAmSat, regional systems, and domestic satellites, many of which are designed with regional coverage. In a few years, the Asia-Pacific region has moved from a shortage of satellite capacity to a potential excess: "In fact, so many regional birds are being launched that a glut of capacity exists, driving down prices for end users. This scenario could lead to consolidation or business losses for operators in the region."[2]

Yet not all of the potential customers for satellite services in the region may benefit, as restrictive policies and lack of terrestrial infrastructure may preclude access to new satellite services. This paper examines the issues surrounding the increase in satellite capacity serving the developing countries and emerging economies of the Asia-Pacific region, and derives lessons from the Asia-Pacific's satellite experience.

2. The Proliferation of International and Regional Satellites

Intelsat continues to provide global and regional connectivity, but has also developed new strategies to serve Asian nations. In addition to providing more capacity, higher power and greater connectivity on its Intelsat VIII series, Intelsat has negotiated with China's ChinaSat for the use of half of the transponders on ChinaSat 5 to give additional C band coverage of the region and has leased 11 C-band transponders on India's 2-E for additional capacity over the Indian subcontinent. Intelsat has also created an additional Asia-Pacific customer service area with an initial satellite located at 91.5 degrees East.[3]

PanAmSat achieved global connectivity including coverage of Asia and Africa in 1995. Its Pacific and Indian Ocean satellites cover the region, and provide links to Europe and North

America. PAS-4, which covers South Asia and the Indian subcontinent, now carries numerous international television signals on its South Asia/ Middle East beam.[4]

Asiasat 1, launched in 1990, opened a new era in Asian telecommunications, offering high powered capacity for television distribution, data networking and domestic telephony. Based in Hong Kong, Asiasat is owned by Cable and Wireless, China International Trust and Investment Corporation (CITIC) and Hutchison Whampoa. Television broadcasters from China, Mongolia, Pakistan and Myanmar (Burma) use AsiaSat for domestic distribution. However, AsiaSat's most significant impact has been through its distribution of News Corporation's Star TV, a group of commercial channels designed for pan-Asian audiences. AsiaSat 2, launched in 1995, covers 53 countries including Asia, the Middle East, Australia and Eastern Europe.[5]

APT's Apstar, also based in Hong Kong, became AsiaSat's first major competitor with the launch of Apstar-1 in 1994. Apstar-1's footprint reaches from Korea and Japan to Indonesia and west to eastern Russia. Apstar 1A includes coverage of India. Apstar 2 was lost in a Chinese launch failure in 1995, but is being replaced by Apstar 2R, with a total of 44 transponders and coverage of Asia and Australia and parts of Europe and Africa.

3. National Satellite Systems

Satellites have many advantages for countries such as Indonesia and the Philippines, with archipelagos consisting of thousands of islands, and for countries such as Vietnam and Laos with very limited infrastructure and unserved rural and remote communities. However, there is not necessarily enough demand in each developing country to justify its own domestic satellite system.

Nevertheless, Indonesia, India and China are being joined by new members of the national satellite club including Thailand, Malaysia, South Korea, the Philippines and Laos (see Table 1). These national systems are being designed with regional beams so that they can provide services to their neighbors, but the neighbors seem intent on procuring their own satellites. As noted above, capacity is also available from regional and international systems including AsiaSat, Apstar and PanAmSat, as well as from Intelsat.

3.1. Indonesia

In 1976, Indonesia became the first developing country with its own domestic satellite system. Indonesia's second generation satellites cover both its own archipelago and the neighboring ASEAN nations. Its third generation Palapa C series provide coverage from Iran to Vladivostok and south to Australia and New Zealand.

In 1993, state-owned PT Telekom and PT Indosat established a joint venture called PT Satelit Palapa Indonesia (PT Satelindo) with privately owned PT Bmiagraha Telekomindo to operate the Palapa system. In 1995, De Te Mobil, a subsidiary of Deutsche Telekom, bought a 25 percent stake in Satelindo. Another consortium called Indostar comprising state-owned and private companies is investing in four small satellites designed for domestic direct-to-home digital TV and audio services.[6]

3.2. India

India began experimenting with satellite communications for rural development in the 1970s, when it "borrowed" NASA's ATS-6 satellite to transmit educational television programs to community receivers in rural villages. India's first domestic satellite was launched in 1982. The Insat system is now in its second generation, providing television distribution, long distance telecommunications, data relay and meteorological earth observation. To date, all transponders are provided without charge to state agencies; the Department of Space is considering leasing transponders to private users.[7]

3.3 China

China began using satellites for domestic communications in 1985 when it leased Intelsat capacity to link the remote centers of Urumqi, Llasa and Hohhot with Beijing and Guanzhou. Intelsat is now used to link other remote locations and to transmit China Central Television (CCTV) as well as for private VSAT networks.

In 1988, China launched two domestic satellites that have been used to transmit television and FM radio programs as well as voice and data. A VSAT network provides voice communications for Tibet an and for remote provinces. The Tibetan network first used AsiaSat-1, but has been transferred to Apstar-1.[8]

3.4. Thailand

Thailand's first domestic satellites, Thaisat 1 and 2, were launched in 1993 and 1994, and are owned and operated by Shinawatra Public Satellite Company, which has a monopoly on satellite operations in Thailand until 1999. Thaicom 1 and 2 are used for national and cable television distribution, educational television, VSAT data networks, and rural telephony. The next generation, beginning with Thaicom 3, launched in April 1997, has a C-band footprints that cover Asia and parts of Australia, Europe and Africa, and a regional footprint from India to Indochina. Its high powered Ku band transponders are designed for direct-to-home television distribution for Thailand and surrounding regions with beams covering Thailand and India as well as switchable beams.

3.5. South Korea

Koreasat-1 was launched in 1995, but did not reach geostationary orbit during the launch. Onboard thrusters were used to boost the satellite into orbit, but at an expense of 4.5 years of its projected 10 year life. A second satellite has been colocated at 116 degrees E to provide additional capacity. The Koreasat system has high-powered Ku band capacity for DTH services and high definition television as well as private VSAT data networks and public voice and data services.

3.6. Malaysia

Malaysia's satellite system, Measat, began operation in 1996. Measat is a privately owned venture of Binariang, which also operates domestic fixed and cellular networks. Beams cover the ASEAN nations as well as southern India, and as far as northern Australia and southern China. The system is used primarily for direct-to-home pay television, as well as for distribution of Radio-TV Malaysia and for VSAT networks.

3.7. The Philippines

The Philippines has used satellite technology for domestic services by leasing capacity on Indonesia's Palapa system. In 1995, a consortium of 17 companies called Philippine Agila Satellite Inc. (PASI) announced plans for a national system. However, the largest member, Philippine Long Distance Company (PLDT), left the group and founded another consortium called Mabuhay Philippine Satellite Corporation (MPSC), whose members include several domestic telecommunications and broadcasting companies as well as Indonesia's PT Pacifik Satelit Nusantara and China's Everbright Group.[9]

President Ramos stated that he wanted a Filipino satellite in orbit in time for the APEC (Asia-Pacific Economic Council) meeting held in the Philippines in November 1996. MPSC managed to comply by obtaining Indonesia's B2P satellite (now called Agila I) and moving it into a slot at 144 degrees E obtained from the operators of Japan's Superbird. Agila II is to be launched in late 1997.

4. The National Flag Carrier Syndrome

The "national flag carrier" syndrome that seems to require every country to have its own airline appears to have mutated to satellite systems in the Asia-Pacific region. Despite the introduction of competition in international and regional systems with beams shaped for domestic and subregional coverage, Asia's developing countries appear determined to have their own satellite systems. The symbolic value of a national satellite system is reflected in a trade press article on Filipino satellite initiatives entitled "The Philippines Comes of Age."[10]

This sentiment can be traced back more than two decades to the origins of the Palapa system. President Suharto wanted Palapa to be launched before the 1976 elections; design and construction were constrained to meet this deadline.[11] The satellite policy environment in the Philippines in 1996 was remarkably similar to the situation in Indonesia in 1976. President Ramos stated that he wanted a Filipino satellite in orbit in time for the APEC meeting held at Subic in November 1996. MPSC, the PLDT-led consortium, was able to comply, ironically through its Indonesian member, who was able to arrange acquisition of both an Indonesian satellite and an orbital location.

4.1. From Domsat to National Flag Carrier

In order to justify investment in a satellite system, countries are shifting their focus from strictly domestic coverage to regional and even intercontinental markets. Again, Indonesia was the pioneer. Although the first Palapa was designed specifically for Indonesia, later satellites included coverage of the ASEAN region; Malaysia and the Philippines were major customers.

It may have been Indonesia's success in attracting foreign customers that encouraged other ASEAN countries to invest in their own satellites. An argument given for investing in a Filipino satellite was that it would help reduce the national balance of payments deficit at a faster pace since scarce foreign exchange would not longer be needed for foreign transponder rental.[12] Yet these systems themselves represent an enormous investment of hard currency, as domestic satellite systems (including the satellite, launch, insurance and master control stations) typically cost at least $200 million. (During the APEC summit, the chairman of the US Export-Import Bank signed a letter of intent with MPSC for up to $225 in direct financing for Agila II).[13] Revenue for transponder leases from foreign customers could, however, provide foreign currency to repay loans to build and launch the satellites.

With coverage on Thaicom 3 of the Middle East and parts of Africa, Thailand's Shinawatra will now compete with global operators Intelsat and PanAmSat as well as potentially Arabsat in addition to regional systems such as AsiaSat and Apstar. New generations of Palapa reach from Iran to Australia and New Zealand, while Measat has a similar reach and offers spot beams over India and the Philippines.

4.2. Flags of Convenience

The ITU allocates satellite orbital locations to nations, not to operators. Thus, in order to obtain slots, operators must turn to national governments to act on their behalf. Governments, in turn, may seek to obtain benefits in return for use of "their" slots. The Asia-Pacific region has pioneered an approach that could be called "flying flags of convenience," similar to the practice of shipping companies that register their fleet in countries with favorable regulations and tax policies. Countries too small or poor to have their own satellites can file with the ITU for slots that they can then turn over to satellite investors in return for a negotiated compensation.

Foreign investors who anticipated that trade in orbital slots would be a good business persuaded Tongan officials to sanction "Tongasat", an entity that filed for slots on behalf of Tonga and then leased them to satellite operators. Although the principals in Tongasat may have benefited financially, it appears that the people of Tonga have not benefited from improved telecommunications, despite their rural teledensity of only about 5 lines per 100 inhabitants, and the isolation of their northern islands, which could be ideally served by satellite.

The apparent lack of connection between the satellite slots and the potential of satellites to improve Tongan telecommunications can be seen in information on Tonga juxtaposed in the *1996 APT Yearbook*. Under Government Policy, the *Yearbook* states:

> "An important condition to fulfil the regional development objects of the Tonga government is to ensure the provision of appropriate telecommunications services to the isolated areas...Because of the long distances involved and the low population density, particularly in the Ha'apai and Vava'u Groups, the networks on these isolated scattered islands are invariably much more expensive to install than those in Nuku'alofa, the capital...."[14]

> Under Satellite Systems, the *Yearbook* adds: "To date, two companies have contracted with Tongasat to places satellites into Tonga's geostationary slots. These satellites will cover all of the Asia-Pacific region and will have footprints that can extent to Europe and the Middle East to the East Coast of the USA."[15]

... But apparently not to link Ha'apai and Vava'u to the rest of the country, nor Tonga to other countries in the region.

Another country that allowed a foreign operator to use its slot in return for some compensation is Laos. The Lstar satellite, being built by Space Systems Loral, is ostensibly a Laotian satellite, but is actually a venture of the Thai Asian Broadcasting and Communications Network Company (ABCN), operating under a 30 year concession from the Lao PDR government.[16]

With a national teledensity of only .38, rural teledensity of .18, and a highly rural population, Laos would appear an ideal candidate to benefit from use of a satellite to close its communications gaps. However, in return for a Laotian orbital slot, the Thai investors in the system, who plan to use it primarily for television distribution, have allocated only one transponder for Laotian telecommunications. While digital compression can expand the number of voice/data circuits that can be squeezed onto one transponder, capacity will be very limited, especially if the Laotians plan for television distribution as well as telephony. Also, the very limited existing Laotian infrastructure will require additional investment such as wireless links to neighboring villages, to extend service from each rural satellite terminal.

The Philippine government also hopes to benefit from slots obtained for private operators. When the initial PASI consortium was established, the government was to secure four orbital slots and associated frequencies from the ITU. In exchange for the slots the consortium was to allot the government one free transponder for every 12 available on the national satellite. As noted above, PLDT left PASI, and its new group, MPSC, moved Palapa B2P to 144 degrees East, and contracted for construction and launch of a second satellite. In the meantime, the government acquired 153 and 161 degrees E; it will let MPSC use 153 degrees East in return for the original guarantee of free transponders; other interested parties including PASI will have to bid on the slots.[17]

5. The Last Mile Problem

While satellites are generally an ideal means of serving isolated populations, to extend service beyond a public telephone colocated with the satellite terminal requires installation of terrestrial infrastructure, for example, to connect other customers in the community or to link the station with surrounding villages. At present, very little rural infrastructure exists in many developing countries of the Asia-Pacific. See Table

2.

Of course, lack of infrastructure is a problem that satellite systems are designed to solve, but additional investment is required to build out the network to connect other customers in a village or to link neighboring villages. The existence of rural satellite facilities can provide the incentive to invest in local facilities because of the revenue generated by using the satellite network. For example, in Alaska, several rural telephone cooperatives were established to provide local telephone service after satellite earth stations were installed in the 1970s. However, two factors were important stimulants for this investment: first, the settlement agreements between the "high cost" Alaskan rural phone companies and the long distance carriers enabled the rural cooperatives to keep most of the revenue generated by calls originating and terminating in the villages. Second, rural cooperatives could apply for federal Rural Electrification Administration (REA)[18] loans to build or upgrade their local facilities. The REA program provided loans at below market interest rates and access to technical assistance on design, installation, operation and maintenance of rural telephone systems.

Yet the existence of a domestic satellite system does not seem to have stimulated investment in rural terrestrial "last mile" networks in Indonesia or India, which have had domestic satellite systems since 1976 and 1982 respectively. Palapa was named for the Palapa oath, made by Gjah Mada of the ancient Majapahit Kingdom, who vowed that he would to continue to work until all the islands of the archipelago were united.[19] The government has set an ambitious target of adding 5 million lines between 1994 and 1999, which would raise teledensity to about 2.8. Rural teledensity in 1995 was only 0.2 lines per 100, or 2 lines per 1,000 rural Indonesians. Thus, although the Palapa system has been in existence for more than 20 years, it has not linked most Indonesians in the archipelago. Similarly, India, whose Insat system is almost 15 years old, has a rural teledensity of less than 1 telephone per 100 inhabitants. Insat alone has not been able to bridge the rural communications gap.

India lags behind the average of all low income countries in both teledensity and compound annual growth rate (CAGR). Indonesia still lags far behind the average of all lower middle income countries, but its CAGR is an impressive 14.8 percent. The critical factor appears to be the restructuring of the telecommunications sector in Indonesia, which has created new opportunities and incentives to extend services throughout the country. Indonesia has begun to open basic telecommunications to private investment through incentive plans such as Build Operate Transfer (BOT) and Build Operate Own (BOO). India's restructuring, involving licensing of second local operators, has become bogged down in political upheavals and allegations of corruption. However, investment incentives in Indonesia, Thailand, and the Philippines, which requires installation of rural lines in return for gateway and urban cellular licenses, may spur the rural investment needed to take advantage of the satellite links.

Yet even this restructuring may not result in utilization of available satellite capacity. For example, many countries have adopted the "carrier of last resort" model, designating one carrier (typically the former PTT or national monopoly carrier) with the responsibility of serving rural areas if no other provider offers service. If the carrier of last resort owns or has a major investment in the domestic satellite system, it would have an incentive to use the satellite. If not, it may choose instead to install its own long distance network, even if this choice requires a much larger capital outlay. By installing its own network, it can depreciate its own equipment and retain more of the revenues generated. Thus, for example, in Malaysia, Telekom Malaysia is planning a microwave network for remote areas of Sarawak and Sabah, instead of using capacity on the privately owned Measat domestic satellite.[20]

6. Satellites as Trojan Horses

Asian satellites have served as "electronic Trojan horses", introducing both new services and new operators that governments were reluctant to condone. The most visible example is foreign television content, first introduced by Star TV, News Corporation's package of commercial programming carried on AsiaSat. Star now estimates that it reaches 53 million viewers from Israel to Taiwan. [21]

Although Insat had an eight year head start on AsiaSat, its national TV network, Doordarshan, lost viewers to Star TV. There are now an estimated 900,000 TVRO (TV receive only) antennas in India, but most of them are used to receive programming from AsiaSat rather than Insat. India also has an estimated 40,000 cable TV operators,[22] an industry that was born as a means to redistribute StarTV, and now offers more than 45 satellite channels. In response to Star TV, Doordarshan has revamped its programming, adding more films and soap operas, and a channel aimed at wooing the elite back from foreign channels. Meanwhile, Measat, Thaicom and other satellite operators have aimed beams at India in anticipation of distributing both foreign and domestic commercial television to Indian viewers. India's Modi Entertainment Network will offer a commercial DTH package on Thaicom's India beam.[23]

National broadcasters in other Asian countries are also revamping their program schedules to lure viewers back from StarTV and other imported satellite channels. Some countries have also attempted to prevent reception of foreign channels by banning TVROs. Singapore and Iran are among nations that ban TVROs, others such as China, Malaysia and Indonesia officially allow reception only of domestic programming. To satisfy demand for more television channels, Singapore and China are encouraging construction of cable television systems. The advantage of cable, in addition to controlling access to generate revenue, is that content can be monitored and controlled. For example, Chinese cable viewers were unable to view CNN coverage of the June 4, 1997 rallies in Hong Kong in remembrance of Tiananmen Square were shown.

Satellites also provide a means to bypass the public telecommunications network, regardless of whether bypass has been officially sanctioned by national regulators. India's first packet-switched satellite-based data network, known as Nicnet, was installed by the National Informatics Centre (NIC), a government agency that was able to make the case that it needed its own satellite network to transfer data because the public network was so limited and unreliable. The NIC now has 700 VSATs linking 500 centers; in 1994, it added high speed earth stations linking 14 cities. Its latest project offers satellite-based Internet access using Hughes DirecPC to government agencies, government-sponsored research and education units and other government funded bodies.[24]

Another innovative user of Indian VSAT networks is the National Stock Exchange (NSE), which has established a satellite-based trading system. The newest of India's 23 stock exchanges, the NSE began trading in 1994. By mid 1995, more than 225 members had been linked via satellite to the NSE's mainframe computer, enabling them to view online market information, place orders and execute trades directly from their offices.[25] Yet India's public telecommunications system remains mired in inefficiency, with plans to allow competing operators not yet implemented.

In 1993, China's Ministry of Posts and Telecommunications (MPT) deregulated VSAT data networks, spurring implementation of private VSAT networks and competition in VSAT services. Apart from the MPT, several other state agencies have their own VSAT networks, including the Bank of China, stock exchanges, Xinhua News Agency, People's Daily, Customs, Civil Aviation, Ministry of Communications, Ministry of Energy, and the People's Liberation

Army.[26]

In these and other Asian nations, satellite "Trojan horses" have introduced private and competitive value-added networks, even where the public networks remain public monopolies. Though little publicized, these VSAT networks linking businesses and government agencies may generate the greatest economic benefits of all the satellite-based services.

7. Satellites: The Invisible Infrastructure?

As noted above, many developing countries in the Asia-Pacific have invested in satellites to deliver television and to provide voice and data services. Others use Intelsat, PanAmSat and regional satellites for domestic communications. Yet satellites do not seem to be considered part of the "information infrastructure" being planned under Asian or Asia/Pacific Information Infrastructure (AII or APII) initiatives.

Most discussion of AII in the region focuses on extension of optical fiber networks for Internet access and broadband services such as ATM. Malaysia promotes its Multimedia Supercorridor near Kuala Lumpur as the showpiece of its Vision 2020 strategy; Indonesia cites its microwave and fiber optic backbone linking major cities. At a meeting of APT representatives in Bangkok on information infrastructure in June 1997, national and regional satellites were almost completely ignored in the review of plans for AII. Yet satellites have enormous potential to provide not only basic telephony but also capacity for Internet access, distance education, telemedicine and teleworking in rural and remote areas of the Asia/Pacific.

8. Lessons from the Asia-Pacific Experience

Of course, the experience in the Asia-Pacific region is not unique; other developing countries have faced similar obstacles to maximizing benefits from their investment in satellite systems. However, the Asia-Pacific has the longest experience with national systems, and the greatest number of national and regional satellites outside North America. The lessons of its past 20 years may yield valuable insights for future satellite endeavors in the Asia-Pacific and other developing regions.

- **Incentives for Investment:** Perhaps most important, investment in satellites alone will not overcome communications gaps. There must be investment in terrestrial infrastructure, and incentives to extend this infrastructure in areas that are not highly attractive to investors.

- **Incentives for Usage:** In addition, there must be incentives to *use* the satellite system. Even where there is demonstrable unmet demand, a satellite can soon become a white elephant if operators have no incentive to use it, but may choose instead to install their own networks, even if these are more costly.

- **Regulatory Reform:** Third, the regulatory environment must facilitate satellite operations, for example through legalization of bypass and requirements for interconnection agreements between satellite and terrestrial carriers.

- **Starting with Users:** Finally, as with all telecommunications planning, it is important to understand users. Satellite operators that have recognized unmet demand for video and data services have been successful through responding to user needs. Among the factors to consider are service requirements, pricing, and communities of interest, i.e. where users need to communicate. These factors may be particularly relevant for the new LEO (low earth orbiting) and geostationary satellite systems that plan coverage of the Asia-Pacific region. A satellite system that links a rural fieldworker to a home office only by transitting through the terrestrial networks of another country is not likely to be able to offer affordable or even perhaps reliable service. A system that cannot withstand heavy rain, humidity or dust will not deliver the reliable services that users will come to expect.

As the above analysis demonstrates, the extension of reliable telecommunications to developing regions of Asia and the Pacific requires more than investment in satellite technology. As Arthur Clarke, the first to propose geostationary satellites, said in 1983: "We have now reached the stage when virtually anything we want to do in the field of communications is possible. The constraints are no longer technical, but economic, legal, or political."[27]

Table 1:
Developing Countries' National Satellite Systems in the Asia-Pacific Region

Country	System	Date of First Launch
Indonesia	Palapa	1976
India	Insat	1982
China	ChinaSat	1988
Thailand	Thaicom	1993
South Korea	Koreasat	1995
Malaysia	Measat	1996
Philippines	Agila	1998*
Laos	Lstar	1998

*Agila 1 was purchased from Indonesia and moved to cover the Philippines in 1996.

Table 2:
Rural Teledensity in Selected Developing Asian Nations[28]

Country	Teledensity 1995	Teledensity outside largest City: 1995	Per capita GDP: 1994 US$
Cambodia	1.01	0.05	$213
China	3.35	3.23	424
India	1.07	0.95	287
Indonesia	2.10	0.2[29]	920
Laos	0.56	0.07	289
Malaysia	18.32	14.73	3,622
Myanmar (Burma)	0.38	0.18	1,348
Philippines	2.58	0.95	968
Thailand	7.66	2.94	2,439
Vietnam	1.58	0.71	1,262

Table 3:
India and Indonesia:
Change in Teledensity: 1984 - 1994[30]

	Teledensity		
	1984	1994	CAGR*
India	0.39	1.07	10.7%
average of all lower income countries	0.36	1.48	15.1
Indonesia	0.33	1.33	14.8
average of all lower middle income countries	4.51	8.40	6.6

*Compound Annual Growth Rate

REFERENCES

APT Yearbook 1996. Bangkok: Asia-Pacific Telecommunity, 1996.

Boeke Cynthia and Robustiano Fernandez. "Via Satellite's Global Satellite Survey," *Via Satellite*, July 1997, pp. 32-38.

Dance, Teresa. "The Philippines Comes of Age." Asia-Pacific Satellite, February 1997, pp. 23-25

Hudson, Heather E. *Communication Satellites: Their Development and Impact*. New York: Free Press, 1990.

Hudson, Heather E. *Global Connections: International Telecommunications Infrastructure and Policy*. New York: Van Nostrand Reinhold, 1997.

"Internet Boost for NICSI." *Asia-Pacific Satellite*, June 1997, p. 4.

ITU, *Asia-Pacific Telecommunication Indicators 1997*. Geneva: International Telecommunication Union, 1997.

ITU, *World Telecommunication Development Report 1995*. Geneva: International Telecommunication Union, 1995.

ITU, *World Telecommunication Development Report 1996/97*. Geneva: International Telecommunication Union, 1997.

Narain, Ravi. "A Floorless Exchange." *Asian Communications*, June 1996, pp. 50-51.

Waller, E. "All Systems Go." *Asia-Pacific Satellite*, June 1997, pp. 40-42.

NOTES

1. Boeke Cynthia and Robustiano Fernandez, "Via Satellite's Global Satellite Survey," *Via Satellite*, July 1997, p. 38.

2. Boeke, ibid.

3. *APT Yearbook 1996*,Bangkok: Asia-Pacific Telecommunity, 1996, p. 248.

4. Ibid., p. 248.

5. Ibid., p. 248.

6. Hudson, Heather E. *Global Connections: International Telecommunications Infrastructure and Policy.* New York: Van Nostrand Reinhold, 1997.

7. *APT Yearbook 1996*, p. 258.

8. *APT Yearbook 1996*, p. 342.

9. Dance, Teresa. "The Philippines Comes of Age." *Asia-Pacific Satellite*, February 1997, p. 23.

10. Ibid., p. 23.

11. Hudson, Heather E. *Communication Satellites: Their Development and Impact.* New York: Free Press, 1990.

12. *APT Yearbook 1995*, Bangkok: Asia-Pacific Telecommunity, 1996, p. 404.

13. Dance, p. 25.

14. *APT Yearbook 1996*, p. 556.

15. *APT Yearbook 1996*, p. 557.

16. *APT Yearbook 1996*, p. 264.

17. Dance, p. 25.

18. Now called the Rural Utilities Service (RUS).

19. *APT Yearbook 1996*, p. 363.

20. Both Canada and Australia have invested in domestic satellite systems, but still rely on terrestrial networks for many rural and remote areas. Bell Canada had no incentive to use Telesat Canada's Anik system in the 1970s, and chose to build microwave networks in northern Ontario, for example, using Anik satellites only to reach the mid and high Arctic. Telecom Australia (now Telstra) chose to build a microwave network to link isolated Outback communities in the 1980s rather than using the domestic Aussat system.

21. Hudson, 1997.

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22. Waller, "All Systems Go." *Asia-Pacific Satellite*, June 1997, p. 41.

23. Waller, E., p. 40.

24. "Internet Boost for NICSI." *Asia-Pacific Satellite*, June 1997, p. 4.

25. Narain, Ravi. "A Floorless Exchange." *Asian Communications*, June 1996, pp. 50-51.

26. *APT Yearbook 1996*, p. 342.

27. Quoted in Hudson, 1990.

28. Derived from ITU, *World Telecommunication Development Report* 1996/97, Geneva: International Telecommunication Union, 1997 and ITU, *Asia-Pacific Telecommunication Indicators 1997*, Geneva: International Telecommunication Union, 1997.

29. Source: *APT Yearbook 1996*.

30. Source: ITU, *World Telecommunication Development Report* 1996/97, Geneva: International Telecommunication Union, 1997.

Information, Multimedia and Education: The Need for an International Content Classification System and Mark-Up Language

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1. Abstract

This paper proposes a Digital Content Mark-Up Language (DCML) that would address information overload by enabling content in a variety of media (especially the Internet) to be efficiently organized and retrieved. Applications would include a global electronic library, an electronic copyright clearance centre, a powerful new search engine, and an intelligent agent filter. DCML, catalyzed by a new-found and enlightened desire to share information and reform education structures, has the potential to create unprecedented opportunities for economic and social development and to help lay the foundations for a contagious period of Information Age Renaissance.

2. Introduction

Two hundred years ago Thomas Jefferson compared knowledge to a candle, which even as it lights another candle does not reduce the strength and vitality of its own flame. Instead, the two candles shine more brightly together. Jefferson's inspiration is particularly relevant as the Manufacturing Age passes on the torch to the Information Age. Never before has there been such an opportunity for humankind to truly share its knowledge, for candles to be lit across the world, at little cost - indeed at a tremendous gain - to all those involved.

Every day the wheel is re-invented millions of times by billions of people - hundreds of thousands of businesses are working on problems that have already been solved, millions of social and natural scientists are initiating experiments that have already been performed, and thousands of universities are training students to find answers to questions already answered in unread books hidden far away in dusty library stacks. The culprit behind this tragic waste of human time and intellect is not lack of money, technology or wisdom. It's simply that we have long ago lost control of our ever expanding information universe.

Emerging telecommunications technology has done a great deal to improve the creation and transfer of multimedia content (audio, video, text, graphics, etc.), but it is more a contributor to information overload and information anarchy than its savior. Better multimedia Java applets, more vibrant video animation and audio, faster processors and modem transmission rates, and fancier interfaces are all exciting but they only address a small part of the barrier to widespread and effective multimedia diffusion. In the race to develop the next great software code, proprietary platform, specialized application, or bandwidth breakthrough, software engineers, business people and even governments often lose touch with the big picture: the fact that our multimedia content is so poorly organized. This paper will illustrate how the greatest unfolding opportunity and innovation related to multimedia in the Pacific region, and indeed the whole world, lies in the establishment of a simple, yet powerful international content classification system and mark-up language and infrastructure. This organization of information has the potential to help lay the foundations for a contagious period of Information Age Renaissance, where the connection between people, ideas and concepts is facilitated, and most importantly, where an active, organized and compounding discourse of knowledge is nurtured.

3. Background

3.1 Needle in the Haystack

Anyone who has tried to find some particular piece of information on the Internet, even if they are Net-savvy, has likely discovered that there is room for significant improvement with the current generation of information retrieval software and with the organization of information resources on the Internet. Maryanne McNellis describes this problem of finding information on the Web in a recent editorial in the *Financial Post*.

> *The World Wide Web is nothing short of incredible the first time. Unfortunately, in the early years the Web has been something like a library without either librarians or a Dewey Decimal System. Imagine a football field full of books tossed randomly around. No that doesn't adequately describe it. Imagine a city block with single words or phrases stacked around. Netscape's founders made their fortune by creating a way to navigate around the Web. But it's still pretty clumsy. (1)*

Finding information resources from other media like radio, television, and print *as well* as from the Internet, adds further complexity as each media has its own quirky organizational structure. One can spend weeks, months or years researching a topic and still have only scratched the surface. While the hypertext nature of the World Wide Web has its own creative benefits in expanding Net surfers' horizons and allowing for the unexpected, it does little for those who already know what they are looking for. While it may sound ludicrous, when it comes to indexing and cataloguing the Web, it makes more sense for humans to adapt our behavior slightly so computer search engines know what we are thinking rather than to try to build complex algorithms to try to make computers guess the subtle nuances of the human brain and the creative process.

3.2 Embedded Content Descriptors

Even when the first online databases in the 1960s and 1970s were small by comparison to today, it was clear that simple keyword searching was inadequate. What was really needed was a way to figure out what a writer really intended a document to be about. Even humans have difficulty in deciding what information is relevant to a particular question so trying to get a computer to figure it out without help is nearly impossible.

The best way to solve the problem is simply to have a document's author or an editor describe the material in a standardized and organized way for future reference by others. This has been underway in various shapes in forms for some time in libraries, where books are classified under the Dewey Decimal System or the Library of Congress Classification. But the more the body of information grows, the more archaic these systems become. At the same time, there is an increasing need to attach a lot of other non-subject information to a document (copyright status, publisher identification, language, format, etc.). The answer appears to lie in a standardized system of information embedded within content itself, created by either the original author or an editor. Nicholas Negroponte describes the functions of these "header" bits in his recent, best-seller, *Being Digital*.

> *In the next few decades, bits that describe the other bits, tables of contents, indexes, and summaries will proliferate in digital broadcasting. These will be inserted by humans aided by machines, at the time of release (like closed captions today) or later (by viewer and commentators). The result will be a bit stream with so much header information that your computer really can help you deal with the massive amount of content.* (2)

When one sends a file from one location to another (regardless of whether it originated as audio, text, video, etc.), all the information about the file (its format, its subject area, its copyright status, its publisher, an abstract etc.) would be contained in the header. By logically organizing and classifying information, browsers could be designed to be exponentially more powerful, and most importantly, more practical, than they are today.

3.3 End of the Information Rainbow

There are four parallel and growing trends which signal an incredible opportunity for the feasible creation of an embedded header-based contextual information retrieval and storage system: 1) the trend towards digitalization, 2) the emergence of commercial information markets, 3) the growth of the Internet, and 4) improvements in computer processing power and storage.

3.4 Digitalization

Perhaps most important of the information trends, technology is increasingly moving in a digital direction, where all content is represented by a binary series of 0s and 1s, allowing for a compatibility between diverse mediums that was never before possible. This means that identifying headers (information about the information) can also be standardized across any media platform. Digitally embedded information about content contained in an application such as the television based V-chip can now be "media-neutral". Why have a different hardware filtering device and different content standards for each medium - TV, PC, fax, etc. - when the same system could be used for everything!

3.5 Emergence of Information Markets

Another important reason for the growth of information storage and retrieval technology is simply that information has become such an important part of the global economy. A comprehensive survey by Angus Reid of Canadian Internet users found that 54% joined the Internet to access information, 16% because of curiosity, 10% for conducting business, 7% for social interaction, and 5% for personal entertainment. The fact that information access is the number one reason for Internet use shows that a very large market is developing for information products and services. Internet use is switching from curiosity and entertainment to that of an information tool.

3.6 Internet Growth

Another important trend is simply the rapid growth of the Internet. Half of all Internet users came on-line in the past 6-months! (3) The estimates of current and future Internet size vary but all point to a high-growth scenario. The Angus Reid Group estimates there will be 160 million Internet users by 2000 while Internet and media guru Nicholas Negroponte (Professor of Media Technology at MIT, Founding Director of the Media Lab, and Columnist for *Wired*) predicts there will be one billion Internet users by the year 2000! (4) It took America OnLine four years to get its first 100,000 subscribers. Now it gets than many new people logging on every two weeks. (5)

The Internet and its explosive growth offers many valuable lessons about the importance of compatibility. With almost no centralized planning, TCP/IP has connected millions of computers across the globe, computers which operate under thousands of different operating systems but which can now communicate under a globalized, common language. Similarly, the rapid growth of the World Wide Web was the result of Hyper Text Mark-Up Language (HTML). Like TCP/IP, HTML provided a common standard across the world, conveying information to a software browser about a document's intended format and hypertext links. TCP/IP and HTML provide tremendous examples of how an *information content protocol* could also have incredible benefits. Not only could computers from across the world communicate with one another from a technical standpoint, they would also be able to communicate from a content standpoint. Instead of just computers and formats connecting and communicating, people and ideas could more easily connect and communicate. The Internet also provides a valuable test market for new information retrieval concepts. It will be a long time before the world's libraries are completely digitized but the fastest growing library today is the Internet. It's electronic nature makes it an ideal starting point.

3. 7 Processing Power

A final trend that is helping make a world content library feasible is the rapid improvement in processing power and memory storage capabilities. Gordon Moore, the co-founder of Intel, predicts that in a few more chip generations we can imagine putting a billion transistors on a chip (100 times the complexity of today's chips). There are millions of new documents and other items of content being created every day and trillions exist in our various conventional library formats. It is hard to imagine ever having the ability to organize content databases of this magnitude that would enable someone to conduct an information search of *all* content sources in existence in the *entire* world but with the rapid increases in processing power and memory storage capabilities, we are closer than ever to this becoming a reality.

4 Digital Content Standardization Project

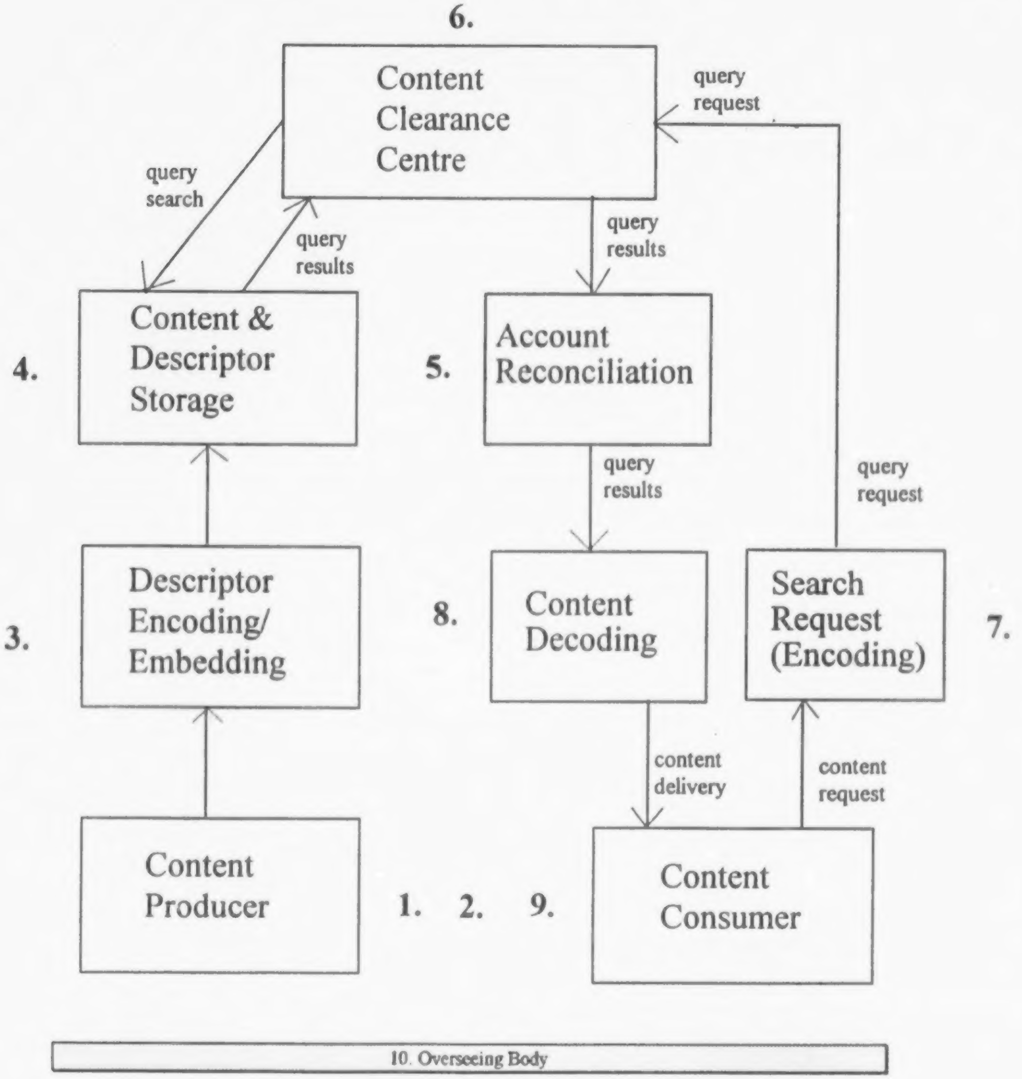
Just like a system of nomenclature was needed to advance the cause of science around the world, so too we need a system of information content nomenclature to advance the cause of society. For the sake of simplicity, throughout this paper I will call this project the Digital Content Standardization Project (DCSP). The project, at this point, is purely conceptual, although there doesn't appear to be any unsurmountable technological or organizational barriers to implimentation. The DCSP would be combined of ten key components: 1) An Electronic Dictionary, 2) An Electronic Encyclopedia of Standardized Concepts, 3) A Digital Content Mark-Up Language (DCML), 4) A Global Content Warehouse System , 5) A Publishers Registration Database, 6) A Content Transaction Clearing Centre, 7) A Filter-Base Query Language, 8) A Filter-It Browser, 9) Associated Tools, and 10) A DCSP Overseeing Body. Figure 1 displays the interrelationship between these components and indicates the flow of information between consumer and producer.

With the rapid growth of the Internet, the potential for every person to become a content producer is incredible. Just like the desktop revolution of the 1980s led to hundreds of thousands of specialty magazines -- published by amateurs with low-cost hardware and software -- the Internet offers this same revolution in a variety of formerly unaccessible broadcasting mediums. Internet guru Howard Rheingold describes this phenomena.

> *The World Wide Web makes it possible for citizens, artists, scientists, activists, educators, entertainers, businesses worldwide to become global multimedia publishers. Because the Web rides on the Internet, anyone with a personal computer and a modem, anywhere in the world, can put up multimedia billboards for all the rest of the (wired) world to see and hear. Every desktop computer within reach of a*

Figure 1

Digital Content Standardization Project: Simplified System Overview


6.
Content Clearance Centre
query request
query search
query results
query results
4.
Content & Descriptor Storage
5.
Account Reconciliation
query results
query request
3.
Descriptor Encoding/ Embedding
8.
Content Decoding
Search Request (Encoding)
7.
content delivery
content request
Content Producer
1. 2. 9.
Content Consumer
10. Overseeing Body

1. Electronic Dictionary
2. Electronic Encyclopedia
3. DCML
4. Global Content Warehouse
5. Publishers Registration Database
6. Content Clearance Centre
7. Filter-Base
8. Filter-It Browser
9. Associated Tools

> *telephone is potentially a (color) printing press and (very slow) radio-television broadcasting station"* (6)

The only thing missing in Rheingold's vision is the difficulty that the hundreds of thousands of content producers have in letting the world know their information is available. Setting up a Web site on the Internet is like getting a phone number; unless people have a way of knowing your number, who you are, and what you are all about, the phone will never ring. What is needed is a universal, standardized system of identifying content so that producers of content (or physical products) and consumers can be efficiently and logically linked. While there are thousands of fresh, ongoing attempts to classify all content, there is a system that has been around for millions of years that already offers an incredible degree of articulation and specificity: that remarkable system is the organization of symbols and concepts which we commonly call language.

4.1 Electronic Dictionary

The building block of the DCSP would be an enormous, evolving electronic dictionary of worldwide scope. This electronic dictionary database would "simply" be a tabled collection of all words in existence, an enormous lexicon. The database would not necessarily be organized in alphabetical order as this ordering system would become redundent since the database key would be based on a numerical series. Since language is constantly evolving, so too would the DCSP electronic dictionary. Although the electronic dictionary database would be enormously large (English alone has more than 750,000 words), in computer database terms it would be manageable. Since it would be organized by numerical rather than alphabetical order, it would be much easier to update than a traditional, hard copy dictionary. (7) In fact, this ability to evolve would be a very important strength of the DCSP classification strategy.

> *... even librarians admit that the schemes used today are antiquated and inadequate: the phrase "classification in crisis" has become a cliche in the library community. The most common systems in the US - the Dewey Decimal System and the Library of Congress Classification - were developed during the close of the 19th century. Unsurprisingly, they are poor at classifying knowledge in "newly" established fields like genetics or electrical engineering. More important, library classification is bound by restrictions that the digital world is not. While a physical book can be shelved in only one place, a digital document can be placed in several categories at the cost of only a few bytes.* (8)

It is clear within the library science community that we need a new system of classification for the world's multimedia content and thanks to the power of relational databases, the electronic dictionary could prove to be the catalyst for this progression to occur. Surprisingly, the Internet community isn't much better than the traditional library sector at classifying information resources. While the Internet currently has some forms of content classification, it is extremely limited. For example Internet newsgroups are divided into very broad categories such as "sci" (science), "rec" (arts, hobbies and recreational activies) and "comp" (computer) and Internet domain names are limited to "com", "org" and "net", etc.

4.2 Electronic Encyclopedia

Organizing words into an electronic dictionary is the easy part of content classification. The hard part comes in organizing these words into concepts, which because of their subtle nature have been the monkey wrench that has brought many ambitious universal classification schemes to a grinding halt. In fact, much of the debate over universal standardization concept lies in the arbitrary nature of defining information. For example, who is the best person to describe and define a published work. Is it the author? Is it an editor? Is it a business person? Is it a literature expert?

While a perfectly absolute system of classification may be impossible, the trick with a classification system is, as Einstein said, to keep it as simple as possible, but not simpler. The electronic encyclopedia would essentially be another tabled database (although this time, much larger) of organized combinations of words (codified into numbers) from the electronic dictionary database. Just like language has different types of words (descriptive adjectives, active verbs, etc.), the word numbers could be codified to describe their functional qualities. Concepts would simply be strings of numbers (defining words and word functions). For example, the concept "portable power generators under 5 kW" would simply be a number combination of the individual words, "portable", "power", "generators", "5" and "kW" and context would be defined by the order the words occurred (general to specific) and the type of word they were (verb, adjective, etc.). (9) The best part of the electronic encyclopedia is that it would, like the electronic dictionary, be able to evolve to encompass all of emerging reality. This would transcend the attempts at concept standardization in systems such as the SIC (Standard Industry Code, created in 1948) that falls apart when entirely new industries are created that no longer fit into a narrowly defined numerical code. It would also transcend language and culture since the database would be numerically linked to concepts (which can be identified in a variety of languages).

4.3 Digital Content Mark-Up Language (DCML)

Of course, words and concept descriptors are only one part of any useful content classification system. A "Digital Content Mark-Up Language" (DCML) would need to be developed which would offer a similar function to HTML. However, instead of describing display formats and hypertext links (like HTML), DCML would describe content. For example, individual content descriptors might include: Abstract, Author, Compression Method, Copyright Status, Country of Publisher, Geographical Scope of Content, Culture, Date, Industry, Keywords, Electronic Encyclopedia Content Description Numbers, Publisher Information, Price, Ethical Filter Ratings, Security Levels, Type of Content Medium, Quality Ratings, Content Size, Billing Method, Delivery Availability, Related Articles, File Location, etc.

The basic concept of DCML is simple: a universal codified structure (much like a content version of HTML) that could exist across computer platforms and even across media platforms (TV, print, radio, etc.) that describes a particular piece of content. Like HTML, DCML could describe a small or a large "section" of content (a whole book vs. a chapter vs. a paragraph). Again, like HTML, the DCML code inputted by the producer could be as sophisticated and comprehensive or as bare-bones as a content publisher wished. (10)

There is some debate in the content classification "community" about who should be the one to define content. The philosophy behind DCML (like HTML) is that the author or producer of a particular piece of content would be the primary one to describe that content, although there would be fields within DCML that would allow for the independent rating and description by more objective third-parties (editors, rating organizations, etc.). With the growth in electronic commerce and electronic data interchange (EDI), DCML would be extremely powerful, since in addition to content description, information about copyright status, price, etc. could be part of the DCML tag line provided by a producer of content. Tim Berners-Lee, the creator of the hypertext and graphical system known today as the World Wide Web, believes the power of content classification should be in the hands of the creator.

> *... My gut feeling is that one should be able to negotiate how one's information is used. The information world is a market, it's up to the individual people - individual creativity - as to what sort of contracts they draw up. If you feel some marketer is going too far [in a biased description of their own content "product"], you [the user of content] can quit. That's what I mean by negotiation.* (11)

This producer-based responsibility for the description (DCML encoding) of content would also take the burden off any one central classification organization. The desirability of a content producer based encoding system can be seen by imagining the consequences if one central authority was responsible for all HTML encoding! The World Wide Web growth would grind to a stop (this is why Web directories such as Yahoo! can't keep pace with the growth of content; they are trying to single-handedly be responsible for all content classification!).

4.4 Content and Descriptor Storage

The organized storage of descriptor tags and full content itself is an important part of a standardized content system like DCML (the classification of content is of no use, if there is no capability to retrieve this content). A master database would be organized to contain all DCML header information. This database would be enormous and would likely be distributed into hundreds or thousands of regionally linked Web-based "header databases". Electronic "warehouse space" would also be available (for a storage fee) to content creators without the desire or capability to have their own data warehouse.

4.5 & 4.6 Account Reconciliation & Content Clearance Centre

In order for DCML to reach its full potential, a centralized system would be needed to coordinate content transactions. A publishers registration database would be set up to facilitate the efficient flow of content. Publishers interested in being part of this global library would sign up (via an automated Web forms system) and receive a unique publisher registration number (similar to an ISSN or ISBN which most major publishers currently use). With this registration, content could be tracked to an individual producer and copyright royalties could be obtained where applicable. A content clearance centre would be the centralized hub of the DSCP where accounts between content producers and consumers could be reconciled. Although it would be "centralized", due to sheer size, it would be organized as a distributed database. As well, there would also likely need to be regional mirror sites to ensure fast access speed from anywhere in the world.

A consumer (who also would need to register) would receive a monthly information bill for all the content they obtained during that month in the same way as they would receive a hydro or telephone bill. Likewise, the producer would receive a monthly royalty payment from the content clearance centre for any copyright fees owed to them. With EDI, this whole process could be automated so that no physical cash, or particular currency is needed. The content clearance centre would allow for transactions of micro-pennies (or yen, pounds, etc.) since the transactional economies of scale would support extremely low variable costs. Producers would have incredible pricing flexibility, flexibility that is today completely impossible with physical rather than electronic copyright clearance centres.

4.7 Filter-Base

From the consumer end of the DCSP, an information user could formulate an efficient search through the use of a "Filter-Base", a simple database language that would allow for simple or complex filtered content searches of DCML content, depending on the need. The user could either use pre-programmed third party filters (Filter-Base add-ins), simple menu based filtering queries, or they could write their own sophisticated query programs. Once formulated, a Filter-Base search could be incredibly powerful since it would focus on content headers (DCML) and therefore could retrieve extremely granular topics (and avoid the problem with Internet search engines where a simple keyword search leads to a list of thousands and often unrelated documents). A Filter-Base program could also act as an intelligent agent, being an excutable search file that is automatically run at pre-programmed intervals. One could have a weekly search for a particular information topic and all the searching could be done at pre-programmed "down time" periods (if a truly global electronic library did form, it might take several hours to do an exhaustive search of all documents in existence on a particular subject, even with the incredible evolution of processing speed) so that a users time would not be wasted waiting for search results. A user would have incredible searching power. In addition to creating subject based searches, they could also search on any of the DCML fields.

4.8 Filter-It Browser

The final critical component of the DCSP would be a "Filter-It" browser that could decode a DCML document (similar to an HTML browser which takes out all the HTML tagging so the user can see a clear, non-coded document). This would be a relatively simple program which would allow content consumers the ability to conveniently browse content.

4.9 Associated Tools

The potential of DCSP tools are limitless. One of the benefits of a universal content classification system is that a lifelong filing storage system could be easily kept. When seeing a good article in a newspaper, or a program on TV or an advertisement, one could just click a mouse or scan a barcode that would contain a publisher number, and an article reference number. With the wave of a scan or click of a mouse, this information could be compiled and a copy of the article could automatically be downloaded into your personal file or printer. In fact, with an add-in Filter-Base program, a user could receive the benefits of the DCSP without even having to understand the workings of DCML. If one was to try to obtain copies of all the references used in this paper, it would be at least a month long research project (even with the references listed). To do this legally (from a copyright royalty perspective) would take much longer. There is no reason why this all couldn't happen in minutes, if not seconds, using DCML scanner technology with a quick scan of a "group reference list" directly attached to this essay. The content users would be happy in that they could locate the exact info they wanted almost instantaneously and the content creators would be happy because through the content clearance centre they could be compensated for their content copyright royalties.

4.10 Overseeing Body

The final requirement for the DCSP is for an overseeing body. The private sector is usually not very effective at establishing broadly-based standards. In fact, it is often in the best interests of most software and hardware companies to be incompatible, unless they absolutely have to tie into network externalities. While it is not impossible to imagine a scenario where a private company initiated a worldwide content classification standard, the more likely candidate would be a United Nations Agency such as the International Telecommunications Union.

4.11 Diffusion Strategy

The success of enterprises such as Netscape's Navigator browser has been its ability to rapidly build market share. (12) With the importance of network externalities in today's information technology and telecommunications market, being quick to diffuse a product is essential. The success of the DCSP depends entirely on rapid and widespread diffusion and acceptance. While this kind of rapid dissemination was almost unheard of in the past, the ability for users across the world to download files from the Internet has made rapid diffusion possible. DCML software could be given away for free on the Internet and to publishers. Revenues would come in the form of transaction fees charged to publishers for collecting copyright royalties (based on a percentage of their "information traffic").

If DCML became like HTML in its widespread use then there would be a great incentive for new content with DCML tags. There is nothing forcing anyone to post their material on the World Wide Web in HTML format, except for the fact that if they don't nobody will be able to access their information in a clear manner! Content producers would have an extra incentive to use DCML since it would allow their content to be conveniently found by content consumers (and this linking is usually the goal of content producers).

5. Benefits of DCSP

Besides making it much more efficient to classify, store and retrieve information, the Digital Content Classification Project has some important side-benefits.

5.1 Addresses Information Overload

There are now approximately 150 million Web pages in existence and this should increase to a billion pages by 2000. (13) The desktop publishing revolution of the 1980s is being repeated with audio, video, etc. on the Internet. (14) Instead of the predicted 500 channel universe, it is possible to have a 500 million channel universe with each Internet user being a broadcaster as well as a receiver. Already, the World Wide Web, the Internet's book of graphical pages, has been doubling every six months. (15)

In response to information overload, many Internet users are cocooning in virtual communities, missing much of the excellent material on the Net simply because it is too difficult to find. With tens of millions of Web sites currently listed with Internet search engines, the chance of finding the site you are looking for (or having your site found) decreases daily.

5.2 Productivity Enhancer

Business professionals spend roughly 60 percent of their average workday dealing with documents - newspapers, newsletters, magazines, financial reports, memos, etc. (16) If DCSP improved this information processing by even only 10%, the savings would be enormous. Imagine if every six months we had to learn and communicate in a new language! While this sounds ludicrous, that is essentially what many people are doing every time they learn a new computer interface and search engine protocol. The DCSP, although evolving would provide a standard and therefore the learning curve would be "one-time only". Moving from company to company or from one region of the world to another would not require an an individual to learn an entirely new information search and retrieval language.

5.3 Facilitates Push Technology

The Yankee Group, a Boston-based market-research firm, predicts that within three years, nearly a third of the projected $19.1 billion in annual Internet revenue - from advertising, transactions, and subscriber fees - will derive from "push" based media (customized information automatically being delivered to the end user rather than the end user having to constantly try to locate information). This whole push-based trend could benefit enormously from the DCSP, since the software intelligent agent could access information universally with ease (because of the DCML header) rather than be limited to private networks which is the focus of most push-based software (e.g. Pointcast).

5.4 Allows for Rating of Content

One of the barriers to the useful flow of information over the Internet is the concern that there are no rating structures. DCML would allow for rating fields that could be used for everything from pornography filters, to ethical business filters, to independent content quality rating bodies.

5.5 Up-to-date

The information contained with the DCSP would be incredibly up-to-date. As soon as a content publisher "posted" a document (or video, or audio content), it would be available in a global library for all to access. Old documents would still be available but using the date component of a Filter-Base query user could avoid thousands of search "hits" when all he or she really wants is the information from yesterday, not ten years ago.

5.6 Medium-Neutral

The best part of the DCSP is that it is medium-neutral, that is, it is not dependent on operating in any one particular medium. Therefore, a radio station, a print product and a Web site could all use the DCML protocol. We wouldn't therefore have the ludicrous situation where a TV content rating system is completely different from an Internet or a movie classification system. There are so many piecemeal solutions being proposed around the world but they only temporarily plug a particular media boat from leaking. As Marshall McLuhan said, "the specialist is one who never makes small mistakes while moving towards the grand fallacy." What is needed in this important period of telecommunications and content convergence is a view for the big picture. It is difficult to predict what will be the delivery mediums of choice in the future. Will it be Web TV, will it continue to be the traditional broadcasting mediums or will it be completely new mediums such as electronic book pads? (17) The benefit of DCSP's medium-neutral aspect, is that it doesn't matter which content delivery approaches flourish, any and all can be a part of the DCSP.

5.7 More Efficient Delivery Channel

The current delivery channel of information products is inefficient and wasteful. For example, the "ritual of trucking around books, newspapers, and magazines, it's so inefficient that half the copies of a typical paperback are thrown away, unsold." (18) Futurists and technologist have long been talking about the shipment of data bits rather than physical objects. The DCSP would greatly help delivery move in this more efficient direction.

5.8 Boosts Electronic Commerce

The biggest impediment to the growth of electronic commerce is not security, it's not computer hardware or software barriers, the main barrier is simply the lack of an organized information structure describing products and services. There are no easy ways to scan the Internet for particular products and as a result electronic shopping is still not meeting its potential. While, hundreds of "middleware" companies are trying to be the "meta-link" between the shopper and advertiser, there is no reason why buyers and sellers can't be more efficiently linked directly (without middleware). As long as there are different formats, standards, etc. there will always be a need for electronic shopping malls, on-line communities, directories, etc. but once a basic content standard is developed, the middleperson link will be increasingly software based and transparent.

6. Conclusion

New technologies are often viewed with cynicism. When television was first introduced, American inventor Lee DeForest commented that "while theoretically and technically television may be feasible, commercially and financially I consider it an impossibility." (19) Similarly, an early executive at IBM said he couldn't imagine the world needing more than three computers. (20) The same cynical attitude could easily be directed towards attempts at universal content classification. Nevertheless, the "electronic writing is on the wall", and it only appears to be a matter of time, before the impossible and absurd becomes a progressive part of everyday life. With the rise in computing power, combined with the potential for standardized content protocol (using HTML as a model) and the user-friendly nature of the World Wide Web, a universal content classification system appears to be closer than ever to becoming reality. What HTML did for platform compatibility, a content mark-up language has the potential to do for the exchange compatibility of information and ideas. It's important to note that both the rich and poor need access to participate in the world's information economy. Any policy of information retrieval that does not address the disparity between the information rich and poor will fail to bring about a truly global mind. If the DCSP is to benefit humanity, it must foster an environment that allows for what John Stuart Mill described in his landmark, *On Liberty*, as free-thinking and "possibility thinking". In order for this to occur, an enormous priority must be placed on both basic literacy and technological literacy by encouraging more funding to education initiatives across the globe. As Industry Canada Minister John Manley says, "access to information should be a basic right to every citizen in the world." (21) As well, we must face the serious questions that efficient information systems give rise to such as: What do you do with the potential millions of employees that are made redundant by efficiency gains in "middleware" software? How do we begin a passionate debate on how best to share the potential gains (and losses) of this information technology revolution? Once this occurs, then the digital information revolution can be transformed into a truly social revolution.

In fact, many sociologists and historians see the information highway as the biggest technological innovation since the Gutenberg printing press. (22) Whether or not this is the case, there is no doubt that it will fundamentally alter the landscape of both international commerce and society. "Ten years from today, you won't recognize either business or culture. There are [technological] forces converging that will change things as we know them," says Mary Frost, a Managing Director in Price Waterhouse's New York office. (23) But for positive change to result from this unprecedented global restructuring, we must not only focus on the technical issues. Alvin Toffler in his book, *Future Shock*, introduced many to the idea of information overload but somehow society is still fixated on the technical issues of getting more information channels flowing faster and a technical solution is proposed for an essentially non-technical issue. With all due respect to the insightful Marshall McLuhen, the medium (despite still being incredibly captivating and powerful) is no longer the message. The message is the message! There is a growing realization of the importance of content and how much of a void the Internet or TV is without quality and easy-to-access content. Ultimately, this message is primarily about connecting people, not television sets or Internet servers.

> *In the long run, the real application is connecting people. It's what is so profoundly wrong with the name 'information revolution'... this is not about information. It's about people connected to people."* (24)

It is no coincidence that the original hypertext Web invented by Tim Berners-Lee was originally designed to let far-flung researchers to connect and collaborate on large problems, to create an information space where scientists from across the world could gather. (25) The Renaissance in Europe from the 1300s to the 1500s was an age of adventure, curiosity, and vibrant accomplishment that swept through society. Five hundred years later, a new Renaissance is giving birth and once again, the movement (although catalyzed by the invention of the computers and the Internet just as in the past it was catalyzed by the invention of the printing press), is ultimately centred on people and communication, not technology.

> *Technology does not drive change at all. Technology merely enables change. It's our collective cultural response to the options and opportunities presented by technology that drives change. (26)*

Given that society chooses intelligent, well-thought out technology paths, there are many indications that the Internet and its information access potential will continue to profoundly change society.

> *It's similar to what the library was 100 years ago, or the telegraph. It will be bigger and better than television. We're not talking about a 500-channel medium. We're talking about 250,000 channels that speak across all borders. It represents who we are, how we act, transact business and engage in relationships. The Internet is about information empowerment. I think it will change world culture."* (27)

Perhaps, the biggest potential for society to be positively impacted from the Internet and a system such as the DCSP is if it raises the knowledge level of individuals and communities and leads us to become global citizens.

> *Knowledge has the effect of freeing the mind from the brutal grip of bigotry. A knowledgeable person is unlikely to be intolerant, because if broad learning imparts any certainty, it is that men, women and children the world over are more similar than different under their variously configured and tinted skins. "To understand everything is to hate nothing," according to the French writer Romain Rolland. Mutual knowledge among people of different backgrounds and faiths leads to mutual understanding, which makes a mighty bulwark against the tragedy of war or civil strife. (28)*

While technology or access to information has never in the past solved humanity's basic problems of starvation, war, greed - perhaps the DSCP will allow us to at least head in a direction of more understanding of one another, lead to further efficiencies in our ability to respond to need, and most importantly, lead to a greater interconnection between people and transformed will to make the positive changes we as a global village are truly capable of.

Endnotes

1. "Time to rewrite the computer industry," by Maryanne McNellis, *Financial Post*, May 25, 1996, pg. 2.

2. *Being Digital* by Nicholas Negroponte, (Vantage, New York, 1995), pg. 179.

3. "Shopping on the Internet: What's in [the] Store? What's In it for Directory Publishers?" *Kelsey Report White Paper #97-7*, Kelsey Group, July, 1997, 19 pgs.

4. "Canada and the Internet," *presentation*, Vancouver, British Columbia, Angus Reid Group, 1997.; Being *Digital* by Nicholas Negroponte, Vintage Books, 1996.

5. "The 21st Century CEO: Imperatives for Growth," *Index Vanguard Team*, 1997.

6. Howard Rheingold, *UBC Certificate in Internet Publishing Outline*, 1997, pg. 1.

7. "When a basic, old-fashioned dictionary just won't do," by Dominic Ali, *Financial Post*, March 29, 1997, pg. 31.

8. "Seek and ye shall find," by Steve G. Steinberg, *Wired*, May, 1996, pg. 108.

9. This process would take more space to properly explain. For the purposes of this paper, a superficial explanation must suffice.

10. It is important to note that the basic concept behind DCML is not new. In fact, it has existed for some time even before HTML, in the form of SGML (Standardized General Markup Language).

11. "The Father," *Wired*, March, 1997, pg. 140.

12. "The browser war," by Steven Levy, *Newsweek*, April 29, 1996, pg. 48-50.

13. "Push," by Kevin Kelly and Gary Wolf, March, 1997, pgs. 12-25.

14. Brent Holiday, MultiActive Technologies, The Coming Bandwidth Explosion, lecture, BCIT, Vancouver, Feb. 14, 1996.

15. "The 21st Century CEO," by the Index Vanguard Team, *Index Vanguard*, 1997, pg. 2.

16. "The New Age of Documents," by John E. Warnock, *Byte*, June, 1992, pg. 257.

17. MIT's Joe Jackobson thinks a working electronic book is just a couple of years away and will have a retail price of approximately $400 (Source: "Digital Ink," by Charles Platt, *Wired*, May, 1997, pg. 210.)

18. "Digital Ink," by Charles Platt, *Wired*, May, 1997, pgs. 162-210.

19. "The only limitations are those of imagination", *Wired*, October, 1995.

20. *Ibid.*

21. Investing in Knowledge by Hon. John Manley, *Global Knowledge Conference*, June 23, 1997.

22. "The Internet: the next stage in man's evolution," by Curtis R. Curtis, *Vancouver Courier*, Feb. 18, 1996, pg. 16.

23. "Technology Forecast: Entertainment, Media, and Communications by Price Waterhouse World Technology Centre (Price Waterhouse World Firm Services, 1995), pg. 1

24. Paul Saffo, Institute for the Future, UBC Certificate in Internet Publishing, 1997, pg. 1.

25. "Interview with Tim Berners-Lee," by Evan I. Schwartz, *Wired*, March, 1997, pg. 140.

26. Paul Saffo, Institute for the Future, UBC Certificate in Internet Publishing, 1997, pg. 1.

27. Michael Wolfe, *Investor's Business Daily* (from UBC Certificate in Internet Publishing, 1997, pg. 3).

28. "In Praise of Knowledge," *Royal Bank Letter*, Vol. 78, No.2, Spring, 1997, Royal Bank of Canada, pg. 3

References

Ali, Dominic, "When a basic, old-fashioned dictionary just won't do," *Financial Post*, March 29, 1997, pg. 31.

"APEC ministers urged to streamline customs," *Reuter*, May 10, 1997.

Beaufils, J.-M., "The Impact of Wavelength Division Multiplexing (WDM) on the Asia-Pacific Network," *Pacific Telecommunication Review*.

Bennahum, David S., "The Internet Revolution," *Wired*, April, 1997.

"'Biometric' future has almost arrived," *Associated Press*, June 7, 1997.

Blackwell, Gerry, "When push comes to shove," *Canadian Business (Technology edition)*, Summer, 1997, pg. 27-29.

Bowers, Richard, "Internet appliance market US$12.5 billion by 2001 report suggests," *COMDEX Computer Show Guide, 1997*, January, 1997.

Busch, Earlene, "Search and Retrieval," *Byte*, June, 1992, pg. 271-275.

Canadians and the Internet, presentation, Vancouver, British Columbia, *Angus Reid Group*, 1997.

"Changes to Internet Domain Names will Encourage Competition, Foster Growth and Stability," *press release*, International Telecommunication Union, April 29, 1997.

Claymon, Deborah, "When push comes to shove," *Red Herring*, April, 1997, pgs. 31-34.

Computers and Education, television documentary, *CBC National Journal*, CBC, July 8, 1997 (transcripts available from www.tv.cbc.ca/-newsworld/national).

Cote, Raymond, "Searching for Common Threads," *Byte*, June, 1992, pg. 290-305.

Darby, "Electronic Commerce, Security, Intellectual Property, and the Internet, by George Darby, *Pacific Telecommunications Review*.

Education and Computers, television documentary, *ABC*, October 6, 1996.

"Eighty organizations sign MoU to restructure the Internet", Foster Growth and Stability," *press release*, International Telecommunication Union, May 1, 1997.

"Electronic tags planned to protect music copyrights on the Internet," *Reuter*, December 5, 1996, pg. 6.

Elkins, David J., *Beyond Sovereignty: Territory and Political Economy in the Twenty-First Century*, (University of Toronto Press, 1995), 308 pgs.

Emerson, George, "See Johnny. See Johnny Surf. Sury, Johnny, Surf," *Canadian Business (Technology edition)*, Spring, 1997, pg. 35-42.

"Father," Interview with Tim Berner-Lee (WWW founder), *Wired*, March, 1997, pg. 140.

Frauenfelder, Mark, "Content-Based Image Retrieval," *Wired*, June, 1997, pg. 82.

"Get Wireless: Who Owns the Airwaves?" *Wired*, April, 1997, pgs. 142-147.

Gillette, Dr. Jay E., "The Information Renaissance: Toward an End to Rural Information Colonialism," *Pacific Telecommunications Review.*

Herwijnen, Eric van, *Practical SGML*, Kulwer Academic Press, 1990, 305 pgs.

Herman, Lawrence, "Canada can make a good case to defend Copyright Act," *Financial Post*, May 21, 1997, pg. 15.

Honey, Kim, "Super-surfer rides Internet wave," *Globe and Mail*, November 9, 1996, pg.C8.

Huxley, Aldous, *Brave New World* (Pengiun Books, Markham), 1932, 200 pgs.

Ikeson, Jean, "Wired Education in the Real World," *The Computer Paper*, September, 1997, pg. 20-87.

Index Vanguard Team, "The 21st Century CEO: Imperatives for Growth," 1997, 21 pgs.

"In Praise of Knowledge," *Royal Bank Letter*, Vol. 78, No. 2, Spring, 1997, 4 pgs.

International Interactive Communications Society - Vancouver Chapter, "Plug in to your Community: Barn Raising in Cyberspace," IICS email newsletter, June, 1997.

Ipsen, Erik, "Capitalism's King Spies Evil in Market-Mad Realm," *Globe and Mail*, 1997.

"It's the revenues, stupid," *Financial Times*, January 2, 1997, pg. 39.

ITU, *World Communications: A wholly new world* (International Publications, 1996), 365 pgs.

Janson, H.W., *History of Art* (Prentice Hall, New York), 1969, 767 pgs.

Kelly, Kevin, "An interview with Hazel Henderson," *Wired*, February, 1997.

Kelly, Kevin, "Push," *Wired*, March, 1997, pgs. 12-24.

Kelsey Group, "Make Mine Meta: The Ultimate Inclusive Directory," *Kelsey Report White Paper #97-8*, August, 1997, 18 pgs.

Kelsey Group, "Shopping on the Internet: What's in [the] Store? What's in it for Directory Publishers," *Kelsey Report White Paper #97-7*, July, 1997, 19 pgs.

Kelsey Group, "Where to from Here? New Decision Rules for New Media," *Kelsey Report White Paper #96-11*, November, 1996, 23 pgs.

Lamberton, Donald M. "Ethical Issues for Telecommunication: An Australian Perspective," *Pacific Telecommunications Review.*

Legere, John J. (President and CEO of AT&T Asia/Pacific), "New Technologies, New Environment: A Blueprint for Continued Success in Asia Pacific" *Presentation*, APEC Business Forum, Shangri-La Hotel, Manila, Philippines, November 22, 1996.

Levington, Jennifer, "What are the schools wired to?" *Globe & Mail*, June 26, 1997, pg. C1.

Leyden, Peter, "Interview with Gordon Moore," *Wired*, pg. 166.

Lo, Catharine, "Get Wireless: Who Owns the Airwaves," *Wired*, April, 1997, pg. 142-166.

Locke, Christopher, "Making Knowledge Pay," *Byte*, June, 1992, pg. 245-252.

Mandall, Charles, "Prometheus on-line," *Canadian Business - Technology*, Winter, 1996, pg. 78-92.

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Marshall McLuhan Centre on Global Communications, Web site, May 1997, www.mcluhanmedia.com.

McCall, Marnie, "What's the pricetag to protect originality," *Vancouver Sun*, Jan. 30, 1997, pg. A11.

McCullough, Michael, "The Death of the Record Store," *BC Business*, August, 1996, pg. 45-49.

McQueen, "Window shoppers hold out," *Fin. Post Internet Special Report*, March 22, 1997, pgs. 49-62.

MultiActive Technologies, "Converging Trends: Freem Fast and Easy Website Creation in Themed Internet Communities," *White Paper.*

Negroponte, Nicholas, *Being Digital*, Vintage Books, 1996, 255 pgs.

Nusca, Mark, "Web commerce wins place in curriculum," *Globe and Mail*, pg. C4.

Nyerere, Julius, *Dilemmas of a New Nation*, 1980, 150 pgs.

Ono, Ryota, "Obstacles to and Strategies for Telecommunication Development," *Pacific Telecommunication Review.*

Platt, Charles, "Digital Ink," *Wired*, May, 1997., pgs. 162-210.

Porter, Michael E. & Victor E. Millar, "How information gives you competitive advantage," *Harvard Business Review*, July-August, 1985.

Powell, Johanna, "The Net gold rush is on," *Financial Post*, September 21, 1997, pgs. 41-44.

Price Waterhouse, *Technology Forecast: Entertainment, Media and Communications* (Price Waterhouse World Firm Services, 1997).

"Push!" *Wired*, March, 1997.

Reynolds, Louis R., Steven J. Derose, "Electronic Books," *Byte*, June, 1992, pg. 263-270.

Rifkin, Jeremy, *The End of Work*, 1997.

Roche, Douglas, *Justice Not Charity*, (McClelland and Stewart, 1976), 180 pgs.

Rowan, Geoffrey, "PC TV," *Report on Business Magazine*, June, 1996, pgs. 86-93.

Samuleson, Pamela, "Intellectual Property," *Wired*, January, 1996, pgs. 135-191.

Schwartz, Evan I., "The Father," *Wired*, March, 1997, pg. 140.

"Search for the Asian Manager," *Economist*, March 9th, 1996.

Shenk, David, *Data Smog: Surviving the Information Glut*, HarperCollins Publishers Inc., 1997, 250 pgs.

Simpson, Glenn, "Internet Users Spooked About Spies' New Role," *Wall Street Journal*, October 2, 1995, pg. B1&B2.

Snow, Marcellus, "Telecommunication Market Structure and Economic Theories of Trade and Development," *Pacific Telecommunications Review.*

Stanley, Dave, "The Information Age and its Effect on the Future of New Zealand and New Zealanders," *Pacific Telecommunications Review*, 1996.

Steinberg, Steve G., "Seek and Ye Shall Find (Maybe)," *Wired*, May, 1996, pgs. 108-182.

Stewart, Thomas, Intellectual Capital: The New Wealth Organizations, Doubleday, 240 pgs.

Stiglitz, Joseph E., "Harvesting the benefits of sharing knowledge," *Financial Post*, June 14, 1997, pg. 23.

Stoll, Clifford, *Silicon Snake Oil*, DoubleDay, 1996, 249 pgs.

Toffler, Alvin, *Future Shock*, Bantam.

Torobin, Jeremy, "Rating system approved by CRTC to curb TV violence," *Vancouver Sun*, June 19, 1997, pg. 1.

Uzumeri, Mustafa, "ISO 9000 and other metastandards: Principles for management practice?," *Academy of Management Executive*, February, 1997, pg. 21-36.

Warnock, John E., "The New Age of Documents," *Byte*, June, 1992, pg. 257-260.

Weatherford, Jack, *The History of Money: From Sandstone to Cyberspace*, Crown Publishers, 288 pgs.

Web communities, *White Paper*, MultiActive Technologies, May, 1997, www.multiactive.com/catalyst/converge4.html.

Willson, Trevor, "Censorship -- Why or why not and who benefits? A Discussion of the relevant ides of John Stuart Mill and Plato," Political Science course paper (unpublished), University of British Columbia, April 16, 1997.

Wolf, Gary, "The Wisdom of Saint McLuhan,," *Wired*, January, 1996, pg. 124-186.

World Communications: a wholly new world, ITU, Agostini Group, 1996.

Wright, Haviland, "SGML frees information," *Byte*, June, 1992, pg. 279-287.

Zorn, Peggy, Mary Emanoil, Lucy Marshall, and Mary Panek, "Searching Tricks of the Trade", *Online*, May/June, 1996, pgs. 15-36.

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The Role Of Network And Information System (*NUSANTARA-21*) In Speeding Up Development Of The Implementation Virtual Campus In Indonesia

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ABSTRACT

Indonesia, with a population of over 200 million spread across 17, 000 islands experiences formidable telecommunication problems. The telephone penetration ratio is only 2,11% (1996) overall, with substantial differences between cities and small towns, urban and rural, and eastern and western Indonesia. Universal access though endorsed by the Telecommunication Act, 1989, has yet to be supported by adequate implementation and a range of social services including health and education which currently suffer from gaps in telecommunication coverage.

Yet from the 1970s Indonesia has been a leader in telecommunication developments in South East Asia. From 1976 the *Palapa* satellite served effectively to overcome geographical problems of distance and isolation. In a developing country, a unique archipelago, *Palapa* has provided strategic and supportive access to all parts of the Indonesian community.

This current telecommunication infrastructure could not properly serve educational institutions especially distance education institutions. However, *NUSANTARA-21* (Network and Information System) as an innovation gives a big hope to overcome the problem of distance education by preparing more telephone lines for media such as the Internet (*WasantaraNet*) at post offices all over the country. *WasantaraNet* will strengthen the implementation of the of Virtual Campus in Indonesia, a concept originally developed by Edith Cowan University Perth Australia. This paper sets the scene for implementation of Virtual Campus Technology thereby enhancing university education in Indonesia.

1. INFRASTUCTURE

In the early stage *NUSANTARA-21* will be established as an information infrastructure connecting the 27 capitals of provinces in the whole *Nusantara* Archipelago and beyond to regional and global information infrastructures. Priority will be given to the development of the role of the Indonesian economy in regional and global trade, as well as Indonesia within the non-aligned countries.

NUSANTARA-21 will also be able to cover the network and information system in several cities which possess high potential and/or actual economic activities. The network and information system in cities can be in the form of a *"ring-road"* with its branches, and likewise, at a national level a network and information system, comprising all of the existing infrastructure and technology can be developed. If there are segments missing in a city, additional new capacity must use future proof technology.

In its subsequent stages, *NUSANTARA-21* developments will match the development of regions and cities in Indonesia. Technology used must be able to give infinite bandwidth as well as high transmission reliability. The area of various existing growth triangles in Indonesia must be continuously observed so that the expansion of *NUSANTARA-21* to the area can be carried out at the right time and can participate in encouraging growth in that area. In smaller geographical and demographically units, development of industrial and trade areas in the whole *Nusantara* (country) also becomes an integral part of the *NUSANTARA-21* objective.

1.1. DEVELOPMENT OF PHYSICAL INFRASTRUCTURES

Nusantara Multimedia Community Access Centers : The development of *NUSANTARA-21* to cover all levels of the *NUSANTARA-21* community with 'density' orientation is not realistic. In the context of

NUSANTARA-21 a community access centers concept is developed covering broadband pay-phone, broadband business centers, networked e-library, and multimedia community kiosks. Aside of that the one which will become the main point to provide community access to *NUSANTARA-21* is service point owned and managed by *TELKOM* (Indonesia Telecom Company) and *POS* INDONESIA (Indonesian Post Office) in all regions of *Nusantara*. It is estimated that in the year 2.000 all capitals of sub-districts in *Nusantara* will already have access to *NUSANTARA-21* at the required real wide band through cheap satellite access, of *PALAPA* B, C, as well as D generation satellites. *Garuda* satellite, and other PCS satellite systems will also operate in Indonesia's region.

1.2. THE EXPANDING POST OFFICE FACILITIES TO RURAL / REMOTE AREAS.

The objective of the component of the Regional Information Service delivery of *NUSANTARA-21* is to improve regional service provision by extending the basic communication network to cover all residents of the country, intensify the postal network in the major economic hubs of the country, strengthen the institutional capability of the postal service to be able to respond to progressive deregulation of the sector, and expand and enhance the information service providers such as *Wasantara* Net (Internet service provider under PT *Pos* Indonesia serves Internet to rural areas and remote places and the Internet cafe at a post office), *Wartels* (Telephone Kiosk) and *Warpostels* (Post and Telephone kiosk). The specific objective is to achieve the following : (i) to extend the postal network in a cost effective manner to provide a universal service by year 2001 (through a phased approach), (ii) to improve PT *Pos's* service quality and operational efficiency, and extend PT *Pos's* delivery capacity and capability through (a) internal institutional development (b) private sector participation (c) effective deployment of information technology, (iii) to intensify communication in the economic centers by developing value added services (such as services through the *Warpostels*, *Wasantara* Net and hybrid mail). These services will also generate additional revenues and increase asset utilization of the retail outlets, and the postal services, thus contributing to the availability of the regional service expansion to remote areas, (iv) to establish a regulator regime to lower entry barriers and private sector development within the sector while providing sufficient regulatory protection to PT *Pos* for a sufficient period of time to build its competitive capacity, (v) to develop a vehicle to promote banking practices and encourage personal savings (through a Postal Bank), particularly among the low-income population segment and rural residents; and to extend the payment system offered by PT *Pos* (Giro Service) to remote areas to promote *"cashless transaction"*, (vi) to expand and to extend the services of *Wartels* and *Warpostels* to include tourism services through a joint venture among tourist service providers.

1.3. INFRASTRUCTURE IN EDUCATION SECTOR

Education sector is an area that is most ready for the utilization of *NUSANTARA-21*. In the national initiative *NUSANTARA-21* will immediately connect main state and private universities all over Indonesia including the Open Learning University (*Universitas Terbuka*) for education and scientific activities as well as education and administration activities. Aside of that, there are also a number of high schools, junior high schools, and elementary schools which are considered ready to enter The *NUSANTARA-21* era and they will also be served by *NUSANTARA-21*. This plan is indeed considered to be the vision of Indonesia in preparing the next generation to be ready and capable of participating in the global information community era. However for many elementary schools and junior high schools all over Indonesia which cannot be caught in the initial stage of *NUSANTARA-21*, the availability of an on-line electronic library will be programmed, and in due time they will be integrated into *NUSANTARA-21*.

2. UNIVERSAL ACCESS IN INDONESIA

Information should be made accessible throughout the country, for it is the strategic factor of economic production. Consequently, Universal Access is a necessity in the age of information. The provision of universal access means placing an affordable telephone service within people's reach; for example, by installing public or community telephones (*Wartel*) within walking distance of people's residences. (Over time, the telephone service is going to evolve into more sophisticated telecommunications services). It might be important to note that both availability and affordability of services are two essential elements of Universal Access.

TELKOM and its *KSO* (Joint Operation Scheme) partners are required to allocate 20 % of their annual investments towards financing the undertaking to achieve Universal Access. Other carriers are required to contribute to *TELKOM* and its *KSO* partners' costs

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towards meeting the obligations to accomplish Universal Access.

Even if the price for the physical access to the present network were affordable, Universal Access in Indonesia would be not available soon. The reasons are the following. *First*, current penetration rate of the telephone service is considerably low. *Second*, the resources devoted to expand the network to underserved and unserved areas, as mentioned above, are limited. *Third*, the geography to be covered is huge and extensive. It is, therefore, obvious that Universal Access, is difficult to achieve in a short time with traditional network technology.

Fortunately, due to the new technology of global and regional mobile satellite systems (MSS), like Iridium, Inmarsat P and Indonesia's *Garuda* be instantly and universally available. However, affordability of this kind of physical access, may not be straightforward. According to reports from providers of MSS services, it is generally higher than that for the current PSTN (Public Switched Telephone Network).

The Universal Access Fund shall be used by the Government to lessen the price difference between physical access to the PSTN and that to the MSS service. Of course, it would not be possible to apply this across-the-board. A better strategy is to provide selective applications for the up most public benefit. One approach is to provide subsidies from the Universal Access Fund to individual subscriber lines that are mainly used by the public in areas where only MSS service is available. These lines might be those that served *Wartel* (telephone kiosks), public phones, hospitals, school, etc. In this case, recipients of the subsidy are no longer the network operator or the carrier, but the individual user or group of users that shall be selected according to social merit. *(Source Conference Background Note 1996)*

With telephone density 2.11 Indonesia cannot do much to implement *"accessibility"* to reach students interactively in rural areas. That is the reason that the Indonesian government introduced *"service point policy"* meaning to share telephone lines, PC, and television for many people in the public places, what we called *Wartel*, *Wasantara* Net at the Post Offices (Internet cafe) and *Kelompencapir* (Listener, Reader, and Viewer group) in the village centers. By using these facilities a large audience can be served and activities will take place from those service points.

3. SERVICES

President *Suharto* declared the year of 1997 the year of Telecommunications to encourage and acknowledge Indonesia's rapidly developing telecom sector. However, with a teledensity of 2.11 lines per every 100 people of the world's fourth most populous nation, any year to come could be a telecommunication year.

A recent Pyramid Research report entitled *"Telecom Market in Southeast Asia"* says national local operator PT *Telkom* plans to invest $6.7 billion in network development between 1995 and 1998, thereby creating major market opportunities for switching, transmission, access network and intelligent network equipment vendors.

In the government's current five year plan, which ends March 31, 1999, some specific targets include increasing local exchange capacity to 10.5 million lines; achieving a call completion rate of 65% for local calls and 45% for domestic long-distance calls; and repairing 75% of all line failures within 24 hours. These mandates suggest a comprehensive desire to develop an overall high-quality telecom system, rather than merely to meet the need for more lines, although the latter would seem to be the most pressing issue.

Rallying to the telecom cause, PT *Telkom* has its own vision-Vision T2001-to launch itself into the world-class operator status.

As PT *Telkom* does its part to meet the government's 10.5-million-line goal by 1999, it is learning the tricks of the network operations trade from Lucent Technologies, in partnership with AT&T. Through what is formally referred to as the Knowledge Transfer Program, Lucent is helping PT *Telkom* in its Vision T2001 project to become a contender in the world telecom arena by 2001. *(Sources: Global Telephony / June 1997)*

Main telephone lines in Indonesia is 4,186,000 (1996) and expected 11,300,000 in year 2000, teledensity is 2.11 lines per 100 people in 1996 and expected 3.31 lines per 100 people in 2000, cellular is 563,000 in 1996 and expected 3,700,000 in 2000.
(Sources: ITU Asia/Pacific Telecommunication Indicators 1997, Pyramid Research estimate and government projections)

Universal Service Obligation (USO) in Indonesia includes : (i) basic services : telephone in rural areas; (ii) enhanced services : remote health care and education, information access of public entities; (iii) welfare services : the disabled, the bereaved, and low-income families; (iv) emergency services : emergency, security and safety networks; (v) public services : operator directory services, public phone and telegraph.

Under "service point policy" the implementation of USO will be more successful even though the telephone density is relatively small, and individual students who live in 6,000 islands will be served by telecommunication infrastructure to enable them to have access through service points (*Wasantara* Net will be available in many post offices in the small cities and rural areas).

In case of educational services in Indonesia *Wasantara* Net will serve students in urban and/or rural areas, in the cities and/or the remote areas and on the beach or mountainous areas.

There are 3 (three) possibilities for students to be served by *Wasantara* Net as follows :

1. Internet in Learning Centers.
2. Internet Cafe in Post Offices.
3. Internet in residential areas.

Due to socioeconomic constraints, option 1 and 2 will be more appealing for educational purposes.

4. EDUCATION

Indonesia has more than 50 public universities and more than 1200 private universities. The only one public Open Learning University is *Universitas Terbuka* serving students in the whole country. Both public and private universities serve the people in the neighborhood or the city close by. No more public universities will be established. Any potential students who live far away from public or private universities can enter the Open University and register his or her name via the nearest post office.

The participation rate in higher education or the universities is only 1,5 million students out of 200 million people and will be 2,5 million by the year 2007. This number is very low compared to the South East Asian countries like Singapore, Malaysia, and the Philippines.

In this respect the Open Learning University plays a very important role in increasing the participation rate in higher education, as well as improving the quality of human resources, currently in the market-place. This is because 96% of Open University students are working people. So far, the Open University (established 1984) has graduated 198,536 teachers and 18,025 non teachers. The total number of graduates is 216,561 .

4.1 *WASANTARA* NET AS A COMPONENT OF THE VIRTUAL CAMPUS

Because of *WASANTARA* Net has spread out to rural, remote area in the whole country, the accessibility of the people to use *Wasantara* Net as Interactive Media has became a reality. *WASANTARA* Net has covered 131 cities and towns all over Indonesia, and operates Internet cafes in 31 locations. There will be more Internet cafe services in a few months. The benefit of this accessibility is educational and the Indonesian Open Learning University (*Universitas Terbuka* / UT) will take advantage of these services. The Indonesian Open Learning University was established as a public institution in 1984 to provide access to post secondary education for high school graduates as well as to improve the qualification of teachers. Today, UT serves almost 400,000 students (300,000 of them are teachers) through four schools and 32 regional centers. At present, the delivery methods used by UT to reach students is mainly print-based. In the very near future, UT intends to use (interactive) electronic delivery for about 5% of the instructional activities in addition to print and broadcast media.

The big hope for the Open University is to accept potential students from rural , islands ,and remote areas as well as those who are already working as teachers, armed forces, banks, pilots, policemen, and even prisoners.

The Indonesian Open University serves students who live in almost 6.000 islands, 96% of them are working. The Open University serves its students mostly through printed material, very little broadcasting and the Internet at an early stage. Students need more interactive media like the Internet or the Virtual Campus because they prefer to stay in their own home, working in their current job while studying at the Open University. Therefore, students need multimedia for their learning process and will manage their learning from home (if they can afford to buy PC and telephone) or from a service point such as learning centers and post offices.

By having 2.11 telephone density for 100 population, and most of the telephones lines centered in the cities or urban areas, it is very difficult for those who live in the rural/remote areas to have access to a telephone line . Therefore, the Indonesian Government Policy to develop *WasantaraNet* through *NUSANTARA-21* Project at the Post Offices will be a good solution.

5. VIRTUAL CAMPUS (AT AN EARLY STAGE)

Once local in orientation, universities are now increasingly thinking nationally and globally. Using the Virtual Campus at Edith Cowan University (ECU) as an example, we find advanced convergent communication technology projecting on-campus resources and experiences into rural and remote locations across the Australian continent and world-wide. These services are achieved with minimal loss to what would be gained from on-campus, face-to-face teaching and learning experiences.

Yet typically around the world, students at a distance in the 1990s still rely heavily on one-way non-interactive delivery of courseware by radio, television and postal services. Any interactivity in this context is restricted largely to regulated student feedback, e.g. by completing assignments and sitting tests and examinations.

ECU was one of the first universities in Australia to break out of this mould by developing a user-friendly computer-based system for interactive communication with students. The system, formally registered as the *"Virtual Campus"* now supports over 10,000 users. ECU has long been a major provider of tertiary level distance education and for at least a decade has been concerned with communication delays and barriers between the home campuses in Perth and students located thousands of kilometers away. Research and development within the Faculty of Science, Technology and Engineering at ECU initially resulted in a relatively simple text-based interactive system, computer to computer, with services designed to meet the expressed views of students. Subsequently, with increasing bandwidth and computer capability, it has been possible to introduce more cheerful and stimulating interactivity, including color, graphics, audio and video via the Internet. This enhanced *"Virtual Campus"* now has strong student appeal. Yet for some, it has decided limitations: e.g. to access the new system, students need a suitably enhanced computer platform. Moreover the demand for increased bandwidth tests the capability of existing communication networks. It follows that the new Virtual Campus should retain the best features of the old, if only to satisfy those students with lower capacity computers. Put differently, students using 286 machines will still be able to log on to the Virtual Campus and interact in text-only mode by exercising Terminal Emulation protocols.

Terminal emulation is the most basic access method: a dial-up connection using standard communication software to a computer called Echidna for text-based information delivery. The student's computer acts as a passive terminal leaving Echidna to run all the applications. Students with more powerful machines may use Point-to-Point Protocol. Point-to-Point Protocol (PPP) enables the student to run applications on his/her own computer, thus providing enhanced presentations; graphics, color etc. The technology underpinning the new Virtual Campus has evolved from its text-only origins and is now better described as a multimedia interactive electronic delivery system. An integral part of this development has been the preparation and presentation of interactive multimedia courseware. The School of Computer, Information and Mathematical Sciences at ECU has developed a set of protocols and associated software to enable speedy transformation of text-based courseware into html (WEB) and CD-ROM formats.

All of these technological developments are equally applicable to higher education in Indonesia. It follows that at least five important reasons can be put forward from implementing the Virtual Campus in Indonesia.

1. To improve the quality of education through *"information"* (knowledge) available at educational institutions, learning resources, media, home pages as well as tutors.
2. To reduce the quality gap among educational institutions (school, universities, non-formal education, professional education, post university education), no matter where these institutions are located.
3. To improve the quality of teachers no matter where they live.
4. To improve the quality of student performance.
5. To increase the participation rate of university education.

The Virtual Campus provides *"just-in-time"* contact and support, and is used in conjunction with traditional printed materials. Students can enter the campus through *Wasantara* Net at the post office at any time, day, or night, seven days a week and avail themselves of the many services provided for them.

The following services and facilities are currently available on the Virtual Campus 24 hours a day, 7 days a week : email, chat, talk, library, news group and send & receive files (up-load/down-load).

5.1. PILOT PROJECT

In order to test the validity and reliability of these benefits of *WASANTARA* NET at the post offices before expanding accessibility, to take part in the Virtual Campus activities, we need pilot projects (experimental projects) in empirical situations. The School of Education or FKIP-UT at this moment has more than 300.000 students comprising elementary and secondary school teachers. They live and teach in all parts of the country and are still teaching in the public schools UT and PT Pos Indonesia have identified three pilot projects under supervision of Edith Cowan University, Perth, Australia in three locations (*Padang* West Sumatra, *Bandung* West Java and *Purwokerto* Central Java).

The first two pilot projects commenced in July 1997 and the third started in August 1997. There are four steps to be examined in these Pilot Projects:

1. The familiarization of the technology equipment.
2. Implementing a simple email, mailing list to practice communication between students and tutors or administrators.
3. Tutorial services for one simple subject matter.
4. Preparation of suitable course materials.

For the familiarization process and for simple administrative services there are also parallel pilot projects at 6 (six) locations : *Jakarta, Medan, Pekanbaru, Semarang, Ujung Pandang* under supervision of the Center for Media Research UT using IndoNet Service Provider. These Pilot Projects are still in progress and evaluation reports will be available mid 1998.

6. CONCLUSION

By expanding post office facilities to remote and rural areas all over the country through *NUSANTARA-21* Projects, there will be more accessibility for students to take advantage of *Wasantara* Net (Internet Cafe). Open University Students who live scattered in almost 6000 islands will use *Wasantara* Net and the Virtual Campus (at an early stage) to communicate interactively seven days a week 24 hours a day to enrich their educational knowledge in the teaching learning process.

The *NUSANTARA-21* Project will speed up the development and the implementation of the Virtual Campus in the very near future. Edith Cowan University, Perth Australia, will help *Universitas Terbuka* in developing the Virtual Campus in its early stages.

But several questions remain unanswered :

Firstly, how do we install, promote and manage our emerging electronic networks and at the same time achieve commercial viability ? The Virtual Campus for example will be dependent in Indonesia on the goodwill and support of Indonesian Post (*WasantaraNet*) and other government agencies.

Then there is the issue of security. The Virtual Campus system ensures that interactivity between lecturer and student remains private to the two parties. There are however examples of privacy being violated notably by so-called hackers. Likewise, assignments and other intellectual property of the students and the system need to be safeguarded.

Finally there is the task of persuading telecoms worldwide that the era of interactivity has arrived; that voice is no longer the only option. Telecoms must stop regarding the Internet and Intranets as peripheral. We must show telecoms that electronic delivery in education (in Indonesia) multiplies telecom usage.

The thrust behind the implementation of the Virtual Campus in Indonesia is two-fold :

1. To provide quality educational service to rural and remote students as if they were on campus and,
2. to equalize educational opportunities for communities that would otherwise be disadvantaged.

The authors of this paper are hopeful that the Virtual Campus in Indonesia will help to achieve these important objectives.

BIBLIOGRAPHY

1. *Conference Background Note, Ensuring National Competitiveness in the Information Economy*, Jakarta 24 - 26 April 1996
2. Corrigan, Marlie. *Virtual Campus. Remote Access to the University network and the Internet.* Edith Cowan University, 1996.
3. Corrigan M.P. and Renner J.M. 1995. *The Virtual Campus : Taking the university to the students, 5th International, IEET Conference*, Bunbury, Australia.
4. *Global Telephony*, June 1997. Pyramid Research: Telecom Market in South East Asia
5. Idris, Naswil, Renner. J.M. 1997. *The Availability of Interactive Media to Perform Better Educational Services to Individual Open Learning Students, Proceedings, 19th Annual Pacific Telecommunication Conference,* Honolulu, Hawaii.
6. *ITU Asia/Pasific Telecommunication Indicators 1997,* Pyramid Research estimate and government projections.
7. Renner, J.M. 1995 *Convergence of Communication Technologies to Achieve Educational Excellence : a case for the Virtual Campus, Proceedings, 17th Annual Pacific Telecommunications Conference,* Honolulu, Hawaii.
8. Renner, J.M. 1996 *Implementing Convergent Telecommunication in Universities; How cost effective, how educationally productive. Proceedings 18th Annual Pacific Telecommunications Conference,* Honolulu, Hawaii.
9. Setiawan, Suryatin, *Towards Indonesian Information Society,* Seminar Mastel, Bandung 27 Juni 1997.
10. *Universitas Terbuka. Statistical Report 1996 & 1997*
11. World Telecommunications. ITU 1996.
12. *Vision and Concept of Network and Information System NUSANTARA-21*, Republik Indonesia, November 1996.

ATM–Based Distance Learning Project in Taiwan

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1. ABSTRACT

Distance learning over a broadband ATM network is a pilot project of National Information Infrastructure in Taiwan to allow students having flexible education opportunities and to enable academic institutes sharing education resources. Three universities, including National Taiwan University, National Chiao-Tung University, and National Tsing-Hua University have joined the distance learning project. Students of these universities can register and take the courses offered by other universities. ATM-based distance learning has been tried successfully in Taiwan and has shown positive results and benefits. New projects of distance learning are under planning to extend the trial scope, to further facilitate the education opportunities, and to share education resources in Taiwan.

2. INTRODUCTION

Distance learning over an ATM network is a pilot project of National Information Infrastructure (NII) in Taiwan [1]. The ATM network has been deployed by Chunghwa Telecom Co. (CHT) since July 1995. The network consists of ten ATM VP switches and thirty ATM multiplexers and provides a high bandwidth backbone for broadband services trial in Taiwan. Distance learning is one of the services provided to allow students having flexible education opportunities and to allow academic institutes sharing education resources.

To establish a communication backbone for NII in Taiwan, CHT has set a strategy to migrate its existing networks to BISDN. According to the strategy, the broadband ATM network trial will be created using the broadband related products developed by Chunghwa Telecom Labs (TL) [2]. During the trial period, a nationwide ATM backbone network and a number of high-speed ATM local area networks have been completed. The local area networks are located in Hsin-chu Greater Science-Based Industrial Park (GSBIP), Tainan Intelligent Science Park, Nankung Software Park, and Harbors of Keelung, Taichung, Hualien, and Kaoshiung. In addition, international ATM trials between CHT and Hong Kong Telecom, Singapore Telecom, and U.S. Sprint have been scheduled to launch soon.

An ATM Virtual Path (VP) switching system and ATM LAN switching system were started in June 1995. A VP switching system is consisted of ATM VP switches (BEX-VPX) and ATM multiplexers (BEX-AMX). User applications are based on permanent virtual connection (PVC) with DS1 circuit emulation, DS3 circuit emulation, and LAN bridging functions. An ATM LAN switching system is consisted of ATM LAN switches and ATM hubs. The goal of the ATM LAN switching system is to satisfy high-speed transmission demand to interconnect legacy LANs.

By June 1996, ten sets of ATM VP switching systems have been installed at ten sites in Taiwan. Several pilot projects, including telemedicine, video conference, distance learning, and campus networking, have been running on the nationwide ATM trial network. The ATM local area network at the GSBIP in Hsin-Chu has been providing high-speed information transmission services for about seventy companies. Currently, two ATM LAN switches and ten ATM hubs are used for the LAN at GSBIP.

To enhance campus teaching and learning facilities and lower the difference of the education resources among universities, NII steering committee and Ministry of Education (MOE) have been prompting a national distance learning project which serves domestic universities now and will be expaned to cover foreign universities in the near future.

Figure 1 shows the network architecture of the ATM VP switching systems. Based on the provided services of DS1 circuit emulation, DS3 circuit emulation, and LAN bridging functions, applications on LAN interconnection, video conference, distance learning, telemedicine, image transfer, and multimedia database retrieval have been under trying. Many national pilot projects have been running on this trial network. They are telemedicine, distance learning, campus networking, multipoint video conference, and international ATM service projects. These projects are conducted by NII steering committee, Department of Health (DOH), MOE, and CHT.

In this paper, distance learning related projects, including wide band distance learning system, campus network over ATM, multipoint video conference, will be described in detail.

3. WIDE BAND DISTANCE LEARNING SYSTEM

Medical education is a very important area of technological education and has a good progress under the promotion of MOE. MOE, several national universities, and CHT have formed a joined national research team for the development of distance learning research project. In June 1995, under the support of CHT (was called DGT), two fiber lines have been implemented to the medical colleges and affiliated hospitals of Taiwan University and Cheng-Kung University. A DS3 (45Mbps) connection has also been established. At the NII distance learning exhibition in July 1995, National Taiwan University Medical College (NTUMC) used the ATM broadband network for the first time to perform a distance learning speech to GSBIP. The distance learning classroom in NTUMC is connected to the remote classroom based on the Hsin-Chu broadband experimental network. In addition, National Tsing-Hua University, National Chiao-Tung University, TL, and National Center for High-Performance Computing can also perform on-line teaching through this network. The network architecture is shown in Figure 2.

National Taiwan University, National Chiao-Tung University, and National Tsing-Hua University have joined the distance learning project. Students of these universities can register and take the courses offered by other universities. Currently, five remote classrooms have been opened. The five classrooms are interconnected through DS3 transmission interfaces. A Digital Cross Connect system is used to perform a broadcast function for multi-site teaching. In the future, the distance learning will be expaned from Taiwan to foreign countries, including Hong Kong, Singapore, and USA. Based on the successful experience of international interoperability test, the international distance learning trial is expected to work smoothly.

4. CAMPUS NETWORK OVER ATM

In order to extend the scope of distance learning, Ministry of Education and CHT have conducted a campus ATM network project to connect the campus ATM networks of seven universities to the ATM backbone network through DS3/PLCP interfaces. Distance learning has been one of the main applications of this project. Courses in the areas of psychology, finance, sociology, information technology, and science education have been offered.

To share the education resources among universities, MOE has also been conducting a campus networking trial to interconnect the campus networks of seven universities, including Taiwan University, Central University, Tsing-Hua University, Chiao-Tung University, Cheng-Kung University, Chung-Cheng University, and Sun Yat-Sen University. The campus ATM networks of the seven universities are directly connected to BEX-VPXs of the ATM VP network through DS3/PLCP interfaces. The network architecture of campus network is shown in Figure 3. The circuits and interoperability test between ATM campus switches and BEX-VPX ATM switches have been completed. The interconnection testing among ATM campus switches through ATM VP network is in progress.

Video compression cards and ATM interface cards are installed on high performance workstations to provide real-time conversation capability for more than three locations simutaneously. It can also utilize electronic white board to perform multimedia teaching material transmission and broadcasting functions. It further integrates academic networks and uses services BBS, Email, WWW, Gopher, etc. Internet function for live teaching system in the

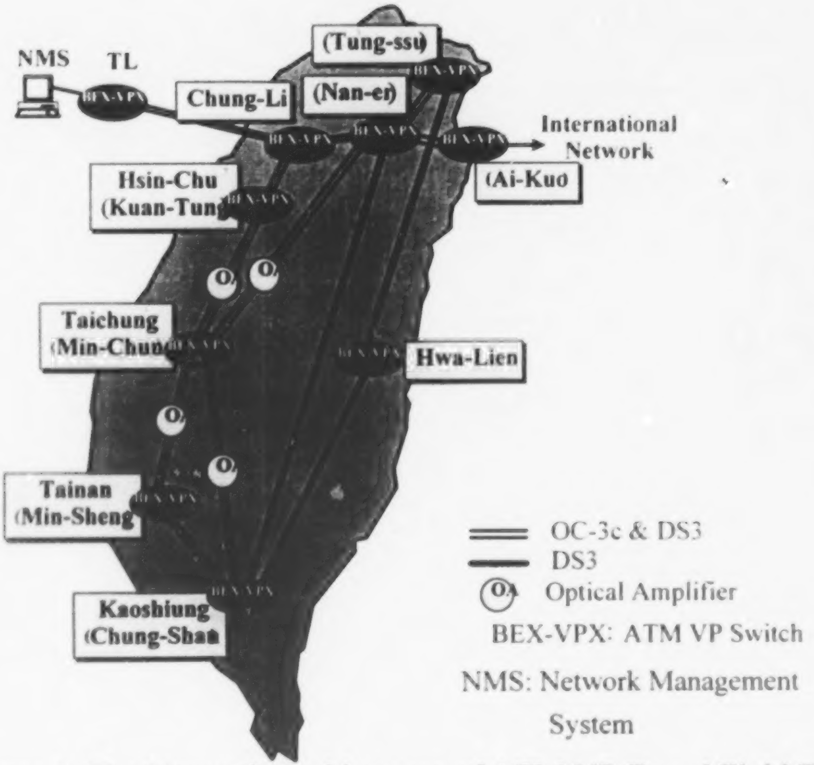

NMS
TL
BEX-VPX
Chung-Li
(Tung-ssu)
(Nan-er)
BEX-VPX
International Network
(Ai-Kuo)
Hsin-Chu (Kuan-Tung)
OA
Taichung (Min-Chung)
Hwa-Lien
Tainan (Min-Sheng)
Kaoshiung (Chung-Shan)
OC-3c & DS3
DS3
OA Optical Amplifier
BEX-VPX: ATM VP Switch
NMS: Network Management System

Figure 1. The Network Architecture of ATM VP-Based Field Trial

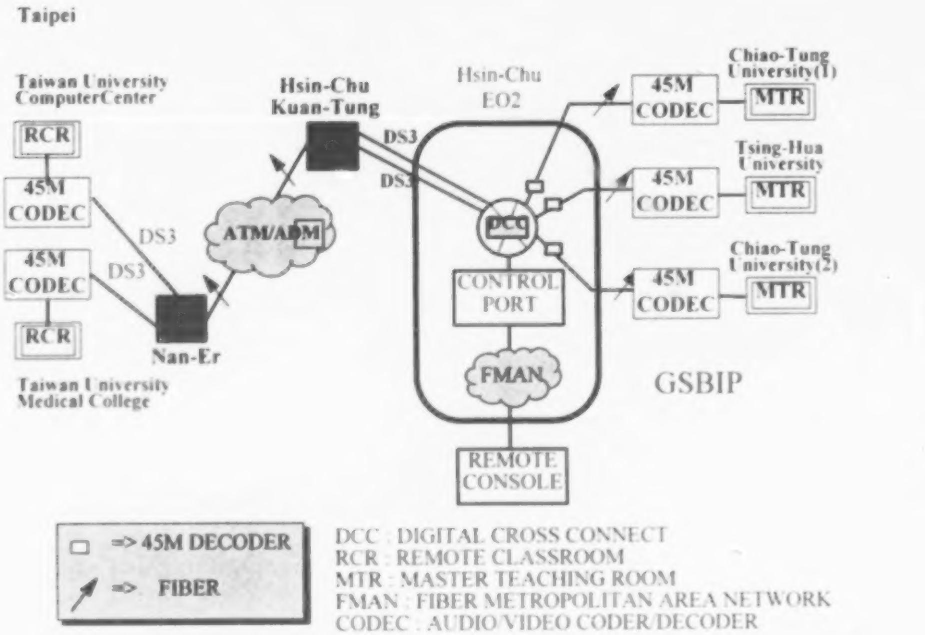
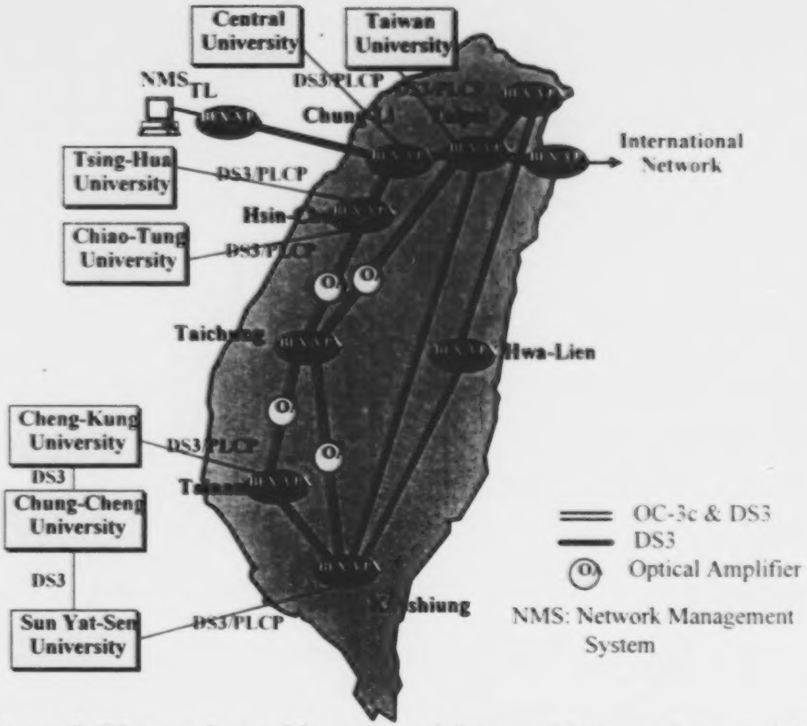

Taipei
Taiwan University ComputerCenter
RCR
45M CODEC
DS3
Taiwan University Medical College
Nan-Er
ATM/ADM
Hsin-Chu Kuan-Tung
DS3
Hsin-Chu EO2
DCC
CONTROL PORT
FMAN
REMOTE CONSOLE
GSBIP
Chiao-Tung University(1)
Tsing-Hua University
Chiao-Tung University(2)
MTR
=> 45M DECODER
=> FIBER
DCC : DIGITAL CROSS CONNECT
RCR : REMOTE CLASSROOM
MTR : MASTER TEACHING ROOM
FMAN : FIBER METROPOLITAN AREA NETWORK
CODEC : AUDIO/VIDEO CODER/DECODER

Figure 2. Network Architecture of Wide Band Distance Learning System


Central University
Taiwan University
NMS
TL
BEN-VPX
DS3/PLCP
DS3/PLCP
Chung-Li
Taipei
BEN-VPX
BEN-VPX
BEN-VPX
BEN-VPX
International Network
Tsing-Hua University
DS3/PLCP
Hsin-Chu
BEN-VPX
Chiao-Tung University
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BEN-VPX
BEN-VPX
Hwa-Lien
Cheng-Kung University
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Tainan
BEN-VPX
DS3
BEN-VPX
Kaoshiung
Sun Yat-Sen University
DS3/PLCP
OC-3c & DS3
DS3
Optical Amplifier
NMS: Network Management System

Figure 3. Network Architecture of Campus Network over ATM

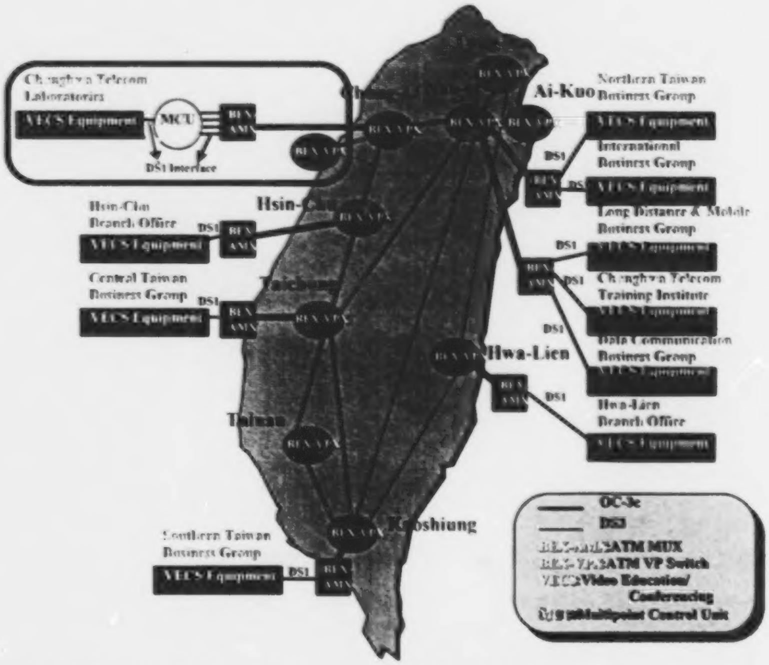
Chunghwa Telecom Laboratories
VECS Equipment
MCU
BEN-AMX
DS1 Interface
BEN-VPX
BEN-VPX
BEN-VPX
BEN-VPX
BEN-VPX
Ai-Kuo
Northern Taiwan Business Group
VECS Equipment
DS1
International Business Group
BEN-AMX
DS1
VECS Equipment
Hsin-Chu Branch Office
DS1
BEN-AMX
VECS Equipment
Hsin-Chu
BEN-VPX
Long Distance & Mobile Business Group
DS1
VECS Equipment
BEN-AMX
DS1
Chunghwa Telecom Training Institute
VECS Equipment
Central Taiwan Business Group
DS1
VECS Equipment
BEN-AMX
Taichung
BEN-VPX
DS1
Data Communication Business Group
VECS Equipment
BEN-VPX
Hwa-Lien
BEN-AMX
DS1
Hwa-Lien Branch Office
VECS Equipment
Tainan
BEN-VPX
BEN-VPX
Kaoshiung
Southern Taiwan Business Group
VECS Equipment
DS1
BEN-AMX
OC-3c
DS3
BEN-AMX:ATM MUX
BEN-VPX:ATM VP Switch
VECS:Video Education/Conferencing
MCU:Multipoint Control Unit

Figure 4. Network Architecture of Multipoint Video Conferenc System

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ATM network can provide inter-school cooperation for better communication on education resources.

5. MULTIPOINT VIDEO CONFERENCE

In addition to the DS3 distance learning systems mentioned above, a domestic DS1 video conferencing system has been established in February 1996 on the broadband ATM network [3]. The system has been used for distance learning and corporate video conference for ten locations around the Taiwan island. Figure 4 shows the network architecture of the system. A DS1 permanent virtual path is established on the ATM network to connect a location to a correspondent port of a multipoint control unit (MCU).

The system use a MCU which is located at TL for the control of conference. The MCU provides networking capabilities with transmission rate from 56 Kbps to 2.048 Mbps. In the system, a DS1 rate has been selected and can support up to 8 sites and up to 4 pairs of multipoint videoconferences can be held simulaneously. The MCU complies with ITU-T H.320 with additional support on functionalities and commands.

Based on this video conferencing system, the employees of CHT and its district subordinate organizations can hold a meeting without the limitation of distance and can save lots of time and transportation cost.

6. CONCLUSIONS

ATM-based distance learning has been tried successfully in Taiwan and has shown positive results and benefits. New projects of distance learning are under planning to extend the trial scope, to further facilitate the education opportunities, and to share education resources in Taiwan.

The distance learning system will connect to not only National Taiwan University, National Tsing-Hua University, National Chiao-Tung University, but also other universities around the Taiwan island through the ATM switching network. The existing broadband network and ATM campus networks of universities will form an island-wide distance learning network.

An international DS1 video conferencing system has also been successfully tested from Taiwan to Hong Kong, Singapore, and USA to create a potential for the offering of international distance learning applications.

In order to promote life-time study and to enhance campus teaching and learning facilities, MOE has been undertaking a distance learning application trial for domestic universities. The long-term aim of the distance learning project is to connect every school in Taiwan, from primary schools to universities, to the NII backbone network and to provide better education programs. MOE has also been planning to have teaching cooperation with the universities in Hong Kong, Singapore, and USA.

7. REFERENCES

[1] J. C. Wang, et al., *NII Distance Learning System Trial Project*, Chunghwa Telecom Labs, Technical Report, June 1996.

[2] C. S. Ling, et al., *Deployment of ATM Broadband Network Trial and Services*, Chunghwa Telecom Labs, Technical Report, June 1996.

[3] C. H. Wang, et al., *CHT ATM Distance Learning System Plan Report*, Chunghwa Telecom Labs, Technical Report, Oct. 1997.

Globalization of Education:
Web-based Education & Training Using the Internet

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1. ABSTRACT

Web-based delivery of higher education and corporate training materials is a current reality. This paper reports on the lessons learned from actually putting the first full and accredited course on the Internet for Hawaii Pacific University, the region's most rapidly growing and private institution for higher learning. Issues related to the globalizatiion of education and business are discussed. Present hot topics in global electronic commerce are reviewed--e.g., multi-lingual, intercultural, and multi-currency dimensions of the privatization of education and training. All of these important aspects have converged now. Real websites using these convergent technologies will be shown. The presentation concludes with a glimpse of the future profile of the global virtual education (virtual.edu) system.

2. BACKGROUND/HISTORY/CONTEXT

We have been interested in distance education, telelearning, virtual training, and so forth for many years; however, it was only in the Autumn of 1996 that the project described in this paper was discussed specifically and in earnest. It was proposed to the administration of Hawaii Pacific University (HPU) that its first (and also in Hawai'i as far as we knew), fully web-based course be put online by the summer of 1997 to cover the same materials contained in Electronic Marketing (EM635) which had been running live, and in person, f2f (face-to-face) since 1995.

Due to factors involving this significant paradigm shift, it was not until March 1997 that the final, formal approval to go online was received by the authors of this paper. Everything needed to be uploaded in early May '97; so needless to say, April was a very busy month!

Fortunately, the skeleton of the course was on the world-wide web by the first (and last f2f?!) session, May 14, 1997. During the ensuing days and weeks, the course skeleton was fleshed out with details, improvements, enhancements, e-mails, chat sessions, and so on. This website was like most others: it is a PROCESS, not a simple project with a beginning, middle, and end. It is ongoing and organic as is explained and described in the following pages.

It should be noted that HPU and other institutions of higher learning have used the web to supplement traditional classroom instruction for some time. The specific market niche that EM635 targeted was a fully web-based course for graduate students, many of whom were working professionals enrolled in the HPU Weekend MBA (WEMBA) Program. The globalization of the learning process must necessarily take into account in its design the fact that students may be in different places on the world and that they have different cultural and linguistic backgrounds as determined by the Keirsey Temperament Sorter. ON-GOING (involving the application of formative evaluation techniques common to the Gagne' format of instructional design) were used in developing and operating this web-based instructional platform. The design of the course utilizes a combination of synchronous and asynchronous methods of presentation, to meet the needs of time and place independent learners typical of a growing segment of adult learners. The initial home page uses HTML

1.0 standard format, owing to the fact that learners may enter the course with various levels of browsers, helper applications, plug-ins, and desktop software.

The University of Phoenix has a similar target market segment, but their online delivery mechanism is restricted to e-mail. All of these and many more programs provide quality education for the "5 million distance learners," according to Pam Dixon (8). "According to a recent ACE 'Campus Trends' survey, 60 percent of public universities said that they plan to offer more courses through distance education programs." (8)

These virtual learners often cite convenience as the major reason for choosing this educational alternative. Research indicates that these cyberlearners have a high motivation to succeed, and several studies have quantified and confirmed significant qualitative differences in the educational performance of such distanced learners. Certainly, their results are no worse than traditional methods of delivering educational content.

In the area of online corporate training, there are some nice examples such as microsoft.com, mcgraw-hill.com, zdu.net, and so forth.

Due to time and space restrictions, the focus of this paper will be the prospective online teacher's perspective on offering a single or several web-based courses per year. Of course, this is only a small part of the overall Virtual University picture. The authors have intentionally left the administrative and support functions of such virtual education for another paper. Also, the student's viewpoint will only be considered indirectly. Furthermore, the entire K-12 experience is outside the scope of this piece of work which concentrates on tertiary (post-secondary) education.

3. DESCRIPTION OF THE EXPERIMENTAL COURSE

An outline of the course, using frames technology, appears in Appendix A. It covers the same material as was historically presented in the live, f2f course. To provide for more interactivity, the website was supplemented by regularly scheduled (and spontaneous) chat sessions, listservs, e-mail, snail mail, FAX, phones, and physical presences--e.g., a field trip to an Internet company.

The instructional design of the course takes into account the preferred learning style of most Business and Marketing Majors, SJ (sensate judgmental) or ST (sensate thinking) as this website was like most others: it is a PROCESS, not a simple project with a beginning, middle, and end. It is ongoing and organic as is explained and described in the following pages.

In the initial phase, learners are walked through a checklist menu system which allows them to: 1) review the syllabus (establishes a cognitive precursor for the course and allows the students to check their entering knowledge level), 2) review the qualifications of the instructors, 3) determine computer and systems requirements, 4) setup E-mail, 5) set up Chat, and lastly 6) determine their temperament style using a on-line Keirsey Temperament Sorter.

At this point learners are then aware of the performance and technical requirements of the course, have their preferred way of learning established, and can chose to proceed or not.

Next, the overall structure of the course, which uses a menu driven HTML 3.2 frames capable format has hot-links for all of the modules of the course available to the student at any time. This provides a multiple learning path capability. This design feature is critical in that research has shown, that different learners approach the learning process via different means. SJ learners like an organized, systematic approach, step-by-step, while NT learners prefer a more globalized approach and may quickly move through the course in any modality or by various learning paths.

The course contains 10 learning modules, with hotlinks to: Chat, Frequently Asked Questions, Meet the Students (an on-line bio sketch which contains information about each student, a photo, and their E-mail address), Glossary of terms, On-line Course evaluation, and submitted student projects.

Within each module there are performance-based learning outcomes stated as module objectives (again cognitive precursors), a self pre-test (so that learners can determine their knowledge level with respect to the content of the module), a generalized overview of the module (for NT learners), In-depth Content (for ST or SJ learners) which may refer to off-line text information, handouts, or course textbook readings, online text, on-line powerpoint presentations, and hot links to reference areas on the Web. There are also study questions, exercises, key words to remember, and homework assignments. Lastly, there is a topical question that prepares learners to participate in the weekly chat session.

The next step in this on-going process is to revise the course, taking into account the nature of the performance based objectives, and incorporating various media formats into the modularized design that support the presentation of the content of the course, and moves the learner through the process via multiple learning paths. In some instances we will be using asynchronous presentations, including animations, still frame graphics, short audio clips, and short video clips based on MPEG-1 formats.

Both the teachers and learners in an online environment must adjust to the new realities of the workplace which is often remote. In many societies there is a problem (especially for the male) NOT to go to the group workplace on a regular basis. As such we will have to recognize the home as a legitimate place to do work too.

4. RESULTS

Using the same instructor evaluation forms and processes, the student evaluations of this course exceeded the university average and were comparable to the preceding f2f version of the course. Much of the informal and verbal student evaluations were positive and favorable. The following quote is indicative of such feedback.

"Thanks Larry, I really enjoyed the course. Getting a good grade was the icing, but the cake was the learning."

Moreover, from the teacher's perspective of evaluating the learner outcomes and results, the experience was once again quite favorable as all students met our minimum expectations. In fact, some the best students exceeded our course requirements--even though it was a compressed 10 week summer (quarter) session, instead of the standard semester time period of the Autumn and Spring academic schedules.

5. SUMMARY AND CONCLUSIONS

Considering that this was a pioneering, experimental course, it is deemed a success according to the measure that ALL of the participant-learners demonstrated the required course competencies by:

1. Posting to the class website before the deadline
    a. Their own website
    b. Supporting PowerPoint presentation related to 1.a. above.
2. Passing both midterm and final exams
3. Participating in the course via e-mail and other forms of online interactions

In summary, we think we have made a solid contribution to the foundation of the emerging Global Virtual University (GVU) by actually running a successful, graduate-level course online. We have gained considerable experience and many insights (e.g., compare and contrast a listserv vs. a Netscape group e-mail) from this endeavor (see Appendix B for detailed do's & don'ts) which will assist us in the continuing process of building GVU bit-by-bit and byte-by-byte.

It is our conclusion, that the substantial benefits in terms of saved time, energy, parking expenses, reproduction costs for materials, and so forth outweigh for many students the inconveniences associated with the limited bandwidth of the virtual classroom. If George Gilder is correct, even that drawback will be overcome in the imminent era of "abundant bandwidth."

6. NEXT STEP(S)

From a technological perspective, the next things that the students want is Audio Enhancement. Naturally, this introduces another level of complexity dealing with sound cards, speakers, microphones, and associated software--not to mention bandwidth.

In addition, the hardest pieces of knowledge and skills to transfer appeared to be in the details of website design and construction. Half of the students can do this remotely, but we're convinced that the other half of the class could greatly benefit from a hands-on session. Therefore, the optimal delivery mechanism for these course materials may be a hybrid solution in the range of 10% f2f learning by doing and 90% education at a distance. 80/20 and 70/30 are other possibilities that further research and development may shed some light on.

Multi-lingual, intercultural adaptations of the existing curriculum for the global market is one of the next steps. Also, making it convenient for people from all over the world to enroll and pay their tuition and fees in the currency of their choice is one of our next goals.

7. SUGGESTIONS FOR FUTURE RESEARCH

A reaonable extrapolation of current trends is that this course will add audio capability in 1998, video in 1999, and VR/3D by year 2000. Each such step in the evolution of technology requires considerable research into appropriate hardware, software, and courseware. It is not at all clear what the optimal path is at the present time. Hence, we'll continue to follow the Internet Marketing Maxim of Launch and Learn or Ready, Go, Set...

Java, Marimba, Castanets and so forth are already on the planning horizon too (9).

Other ideas worthy of further research are as follows:

- amount of time spent online,
- amount of time in chat/class,
- productivity of time online in class,
- utilization of class web site,
- too many/few online links,
- class goals met,
- time spent in traditional reading vs online reading vs doing web page,
- class interaction good/bad/ok, workload vs discussion and benefits of each,
- typing ability
- knowledge of HTML or web editing prior to class vs after,
- knowledge of marketing before/after,
- knowledge of chatting and other Internet resources before/after

8. BIBLIOGRAPHY AND REFERENCES

1. *In Search of the Virtual Class: Education in an Information Society*,, by John Tiffin and Lalita Rajasingham, Routledge, London: 1995.
2. *The Electronic University: A Guide to Distance Learning Programs*,, published by Peterson's Guides in cooperation with the National University Continuing Education Association (NUCEA), Princeton, New Jersey: 1993.
3. "Distance Education: The Wave of the Future," Vol. 32, No.2, The University of Hawaii, Feb. 1997.
4. "School's Out," Lewis J. Perelman, Morrow, New York: 1992.
5. "Making the Jump(s) into Cyberspace: A Discussion on Distance Learning Paradigm Shifts Required for the 21st Century," Jon Blumhardt and Larry R. Cross, *ED Journal*, published by the United States Distance Learning Association (USDLA), January 1996.
6. "Distance Learning," *Peterson's*, Princeton, New Jersey: 1997.
7. *Guide to Alternative Education*,, Educational Research Associates, 8th edition, 1993.
8. *Virtual College*, by Pam Dixon, published by Peterson's, Princeton, NJ, 1996. Pages 12 & 15.
9. *The Red Herring* (August 1997)
10. *Communication News* (July 1997)

9. APPENDICES

Appendix A: Course Outline Using Frames Technology

0. First Time User Front End Matter
1. Chat
2. Learning Community
3. FAQs
4. Module 1: Introduction & Course Overview
5. Module 2: Effective Web Marketing
6. Module 3: Using the Net for Business
7. Module 4: Flowcharting your Website
8. Module 5: Making Homepages
9. Module 6: WWW Browsers & Sites
10. Module 7: Future Developments
11. Module 8: Security & NetSuce$$
12. Module 9: PowerPoint Presentations
13. Module 10: What's New
14. Module 11: Learner Projects
15. Module 12: Instructor's Comments
16. Module 13: Final Examination
17. Module 14: Course Evaluations
18. Module 15: Glossary of Terms

Appendix B: Do's & Don'ts

1. Do take advantage of this new, interactive medium--e.g., provide for online chat sessions, e-mail by listservers, browsers, and regular.

2. Don't just stick your old courseware up online--e.g., think it through as to what is most suitable for telelearning given the lowest common denominator of your cyberstudents.

3. Do realize that this is truly a paradigm shift that has implications well beyond your own course--e.g., registration now requires valid e-mail addresses (both primary & secondary).

4. Don't be surprised at the little details that still trip you up--e.g., one enrollee had a valid e-mail account, but he found out much to his chagrin that his .mil account was not supposed to be used for personal distance education?!

5. Do keep up with this emerging technology--e.g., audio and video streaming.

6. Don't go too fast for your students or your institution--e.g., 3D VR is here now, but would be overgradient for most of your stakeholders.

7. Do listen to your participant-learners and accommodate them in small steps where reasonable and practical--e.g., online chat sessions with automatic transcripts.

8. Don't expect too much out of your institutional resources--e.g., full support for a telecourse (especially a new one) requires weekly (if not daily) adjustments, enhancements, tweeking, and so forth.

9. Do follow the guidelines for good instructional design.

10. Don't be rigid, and inflexible in the midst of this dynamic chaos where things change literally overnight.

11. Do conduct formative (process) and summative evaluations in order to supplement the ongoing feedback procedures (kaizen).

12. Don't hesitate to contact us via lcross@worldpoint.com if you are interested in pursuing any of these topics.

Appendix C: Related Hotlinks
(Note: All Domain Names below are preceded by http://www.

0. www3.worldpoint.com/vu

1. yahoo.com

2. mcgraw-hill.com

3. greenleaf.edu

4. zdu.net

5. usdla.org

6. hcc.hawaii.edu/~digmed/PPDLA/PPDLA.html

7. webster.commnet.edu/HP/pages/darling/

8. uwex.edu/disted/home.html

9. intersource.com~lifelong/dlsites.html

10. ce.utk.edu

11. nova.edu/Inter-Links/education/distance.html

12. pbs.org

13. wiche.edu

14. ed.gov

15. petersons.com

16. dc.enews.com/clusters/detc

17. caso.com

18. mit.edu:8001/people/cdmello/univ.html

Appendix D: Standard Module Template

A. Module Objectives:

B. Pretest

C. Overview:

D. In-depth Content

E. Study Questions

F. Exercises

G. Important Terms to Remember

H. Issues for Discussion:

I. How to meet the Module Objectives

J. References

K. Homework Assignments

L. Tidbits:

M. Extra credit bonus

N. "Chat Session"

O. Special Comment

Digital Video Representation and Transmission – a Tutorial

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1. ABSTRACT

The reasons for using digital representations of video are multiple; but generally derive from the flexibility and power of digital processing with integrated circuit technology via the reduction of video to the common denominator of the bit, albeit vast numbers of bits. Digital has recently become an alternative to analog for capturing, representing, storing, and transmitting visual sources for selective display. The value of any digital alternative in each case must, of course, be measured against traditional alternatives and other digital alternatives (since there are numerous alternative implementations of digital video that meet current digital video standards).

Progressive developments in the speed of digital processing, the capacity of digital storage, and the quality & efficiency of digital encoding (compression), multiplexing, and transmission have made digital video possible, and further advancements in these areas will predictably lead to additional functionality and economy, and consequently more pervasive use of digital video. This paper vies to add clarity to the spectrum of issues in digital video, including practical uses and restrictions for transmitting digital video in the environments of satellite, cable, and high-frequency terrestrial.

2. STRUCTURE OF PAPER.

In order to understand how to get the most out of using digital video this paper reviews the basics of digital video techniques for the layperson in the following sections:

1. Abstract
2. Structure of Paper
3. Aim of Digital Representation
4. Review of Analog Representation
5. Review of Digital Representation
6. Characteristics of MPEG Digital Video
7. Important Cases: Origination, Retransmission, and Switching
8. Conclusion

3. AIM OF DIGITAL REPRESENTATION

3.1 Cost Savings. The video quality experienced via the first major digital video broadcast entertainment systems has generally been judged superior to that of their analog alternatives – a competitive but not a technical necessity. The main advantage of using digital transmission for video has been and will be the ability to use less bandwidth and equipment for reduced operations and infrastructure expenses per program (or more programs at the same cost). Additionally, broadcast automation (made easier via digital) may also lead to operating cost reductions.

3.2 Multiple Programs per Channel (Multiplex). Instead of one TV program per transmission channel – as provided by analog technology – digital technology permits multiple TV programs per each transmission channel. Although TV channels and programs are synonymous in the old hierarchy we must now distinguish between one *TV program* (one exhibition of entertainment, news, or other content) and one *channel* (which is the space and resources employed to carry one digitally modulated signal).

3.3 Compatible Applications. A secondary advantage of using digital transmission for video is predicted to be the inclusion of adjunct data in the broadcast bitstream for various compatible applications. The first such applications have been conditional access for pay-per-view or other differential service levels, an interactive program guide, and audio services. Anticipated future services include local weather information, education, electronic commerce, electronic mail, gaming, etc.

Digital representations for video also empower broadcasters and other video producers to employ digital non-linear editing, special effects, faster (or slower) than real-time transmissions, and other computer processing and synthesis of video. Many editing operations have begun employing digital uncompressed (unencoded) representations, although in the near future, digitally encoded video may also be used for a very limited set of studio production and editing operations. Encoding of video (not only digital, but analog as well) has been crucial to the successful implementation of all video transmission systems, and is dealt with as such a key topic in this paper.

4. REVIEW OF ANALOG REPRESENTATION

The current analog video framework is introduced briefly here for two reasons. There is a strong parallel between analog and digital in the use of *unencoded* formats for

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production, versus *encoded* formats for *transmission* or distribrution; and from this perspective, the situation for digital video is virtually identical to the current analog situation (only with many more sub-options). Secondly, digital video does not exist in a vacuum – it often will be preceded or succeeded by an analog format – so the analog formats are relevant to the big picture.

Traditional analog video representations include the consolidated representations of NTSC, PAL, and SECAM (termed composite or analog-encoded) and the color-basis representations of RGB, YUV, and YP_RP_B, etc. (termed component or analog-unencoded).

4.1 Composite Analog. The goal of the composite encoded representations (NTSC, PAL, and SECAM) is to provide *bandwidth-efficient* video representation for cost-effective live transmission. The transformation of visual sources into composite electronic formats is called encoding since a complex and generally lossy transformation is required to represent the signal efficiently in a limited bandwidth.

Composite analog encoding of video has its downsides. It sacrifices the independence of color and luminance (by fitting them in the same bandwidth), is very susceptible to corruption during transmission, and errs in motion representation for line-interlaced formats (et al.). These attributes of analog encoding lead to a variety of analog encoding artifacts, including: ghosting, inaccurate color, jagged edges of moving objects, herring-bones and other patterns. These artifacts were deemed reasonable in order to achieve technologically and economically feasible color video transmission. *Digital* video must *also* be *encoded* in order to reduce its bandwidth for feasible transmission, leading to a new set of digital-encoding artifacts. It is preferable to avoid composite analog sources for MPEG encoding, since artifacts of both encoding systems (composite analog and MPEG digital) will then be present.

4.2 Component Analog. The goal of component unencoded video representations (RGB, YUV, and YP_RP_B) is highest accuracy representations (more robust with higher quality and fidelity) for electronic production or editing but not for transmission – except over short distances between studio equipment. Analog component representation involves three separate video waveforms, usually transmitted via three separate wired connections. Component representations are considered to be unencoded, and are essentially free of artifacts, but are uneconomical for long-distance transmissions.

4.3 Analog Composite vs. Analog Component. The choice of analog video representation appropriate for a specific requirement demands consideration of the entire system – although it is clear that component video is predominantly used in video production while composite video is predominantly used in video transmission. Each choice aims for the highest quality and lowest cost feasible. The same rationale should be applied in selecting which digital representation is best for any production or transmission application. Fortunately or unfortunately for broadcasters, the flexibility of the digital video standards developed means that *there are far more choices to be made for digital video* implementation than for analog.

5. REVIEW OF DIGITAL REPRESENTATION

5.1 Unencoded and Encoded Formats Again. Digital video representations, like their analog predecessors, involve unencoded and encoded formats; and there is a similar sensibility in using the unencoded format for production (highest quality video, but less bandwidth efficient) and the encoded format for transmission (still high quality video, and very bandwidth efficient, but with the possibility of quality degradation arising from digital encoding artifacts).

5.2 Transitional Video System Design. Since a digital video system may involve display on current analog TV sets, a digital system design should consider the final conversion to analog component or composite video. A transmission system is never any stronger than its weakest link, and there will be some digital-video data-rate above which there is no quality improvement for transmissions to be displayed on analog TV sets.

Summarizing this example, digital transmission to digital-to-composite-analog converters avoids analog composite-encoding *transmission* artifacts, but analog composite-encoding *representation* artifacts will remain in the TV set itself. And since digital encoding for transmission involves additional digital compression-encoding *representation* artifacts, there is a tradeoff between: (1) analog composite-encoding *representation* and *transmission* artifacts, and (2) analog composite-encoding and digital compression-encoding *representation* artifacts (digital transmission is essentially free of artifacts as long as the signal-to-noise ratio exceeds a threshold Eb/No signal-to-noise level).

Noting this example, but thinking in general, it is always important to consider the entire current and future system environment when designing a digital video transmission system.

5.3 Steps in Digital Representation for Transmission. An analog source (film, original visual material, composite or component video) is prepared for digital transmission by six successive steps: (1) sampling, (2) digitizing, (3) source encoding (or compression –which removes temporal and spatial redundancy), (4) multiplexing (in the instance of more than one program per channel – which will frequently be the case), (5) channel coding, and (6) modulation.

Although the last three steps have less to do with representation than transmission, they are necessary to understand in order to evaluate performance of various options for the former three in the context of the entire system – including determining the total number of programs (at a particular average bit rate) which may be transmitted on various media (such as cable, satellite, and terrestrial).

5.4 Sampling and Digitizing. The first two steps involve a rectangular grid of picture samples (pixels) with dimensions according to the aspect ratio and quality level desired from the representation. The horizontal and vertical dimensions of the sampling are termed the resolution (since pixels can be square OR rectangular, the horizontal and vertical dimensions in pixels does not dictate the aspect ratio). The digitization (second) step is quite fundamental, employing either 8 or 10 bits per sampled pixel. Color and luminance resolutions are sometimes the same, but usually color resolution is made less than luminance resolution – reflecting the differential perceptibility of the human visual system.

Quantitative parameters exist for uncompressed (unencoded) video resolution via shorthand: for luminance resolution (D1, ¾ D1, and ½ D1), and for chrominance resolution (4:4:4, 4:2:2, 4:1:1, 4:2:0) with vertical and horizontal dimensions according to Figure 1.

FIGURE 1. SAMPLING DIMENSIONS OF UNCOMPRESSED DIGITAL VIDEO

	HORIZONTAL SAMPLES	VERTICAL SAMPLES	
	NTSC and PAL	NTSC	PAL
LUMINANCE RESOLUTIONS (L.R.)			
D1	704 or 720	480	576
¾ D1	528 or 544	480	576
½ D1	352	480	576
CHROMINANCE RESOLUTIONS*			
4:4:4	L.R.	L.R.	L.R.
4:2:2	L.R. / 2	L.R.	L.R.
4:1:1	L.R. / 4	L.R.	L.R.
4:2:0	L.R. / 2	L.R. / 2	L.R. / 2
4:0:0		Monochrome	

D1 (or full D1) is shorthand language for full horizontal resolution of luminance sampling (usually 720 active out of a total of 864 samples per line). Vertical resolution is generally coincident with the number of active lines of video. ¾ D1, and ½ D1 have ¾ and ½ the number of horizontal luminance samples as D1, respectively. Together with the number of lines per frame (480 active out of a total 525 for NTSC and 576 active out of a total 625 for PAL) one gets the pixel dimensions of a frame – the higher the numbers, the better the resolution (e.g. PAL D1 is 720 x 576, NTSC ¾ D1 is 540 x 480, etc.) MPEG implementations generally require these numbers to be even multiples of 16, so 540, for example, becomes either 528 or 544.

The various resolutions for color are 4:2:2, 4:2:0, etc. Since color resolution is less perceptible, color is usually provided ½ to ¼ as frequently as luminance. In 4:2:2, chrominance is ½ as frequent as luminance (same vertical resolution, ½ horizontal resolution). In 4:2:0, chrominance is ¼ as frequent as luminance (½ vertical resolution and ½ horizontal resolution). In 4:4:4, chrominance and luminance samples are equally frequent. While sampling and digitizing are important as the first steps in generating a digital video signal, the quality of the source material is perhaps more important. Up to this point we have been talking about parameters of unencoded digital video. The next section discusses digitally encoded representation.

5.5 Encoding with MPEG. While sampling and *digitizing* have the quantitative measures detailed in the last section, encoding has no similar scientifically quantitative measures (at least not yet) which tell us what we would really like to know – *how good the picture is in some absolute sense.* Subjective tests – where expert or inexpert viewers grade video quality on some numeric scale – is one current approach to quality assessment, but businesses relying on encoded representation of video are concerned with additional issues, particularly quality comparisons to alternative video sources. Recognizing the lack of any uniform quality measure for digitally encoded video, the further discussion on encoding seeks to clarify the basics of

MPEG encoding and multiplexing, including both what is required and what is sacrificed in order to gain efficient MPEG video compression.

The aim of source encoding is maximizing video quality while minimizing channel bandwidth requirements by encoding at the lowest possible bit-rate. To do this, *MPEG encoding* assigns bits to represent video (and audio), taking advantage of redundant or predictable characteristics. The current video source-encoding standard-set derives from MPEG-2 (actually a *decoding* standard, also known as ISO 13818 or H.222.0, developed by the Moving Picture Experts Group a joint technical committee of the International Organization for Standardization and the International Electrotechnical Commission with the International Telecommunications Union, respectively). MPEG is described in detail by a variety of sources[i],[ii],[iii].

MPEG is a suite of standards for digital video decoding (it specifies an MPEG bit-stream structure so that all MPEG decoders can take it apart, but it does not specify how the bit stream gets put together). Thinking of the broadcasting environment, the underlying algorithms for MPEG were selected so that MPEG decoders could be made much more cheaply than encoders – by putting as much of the complexity in the encoder (and as little in the decoder) as possible.

MPEG uses mathematical algorithms that represent TV frames as composed of macro-blocks, and blocks, with associated motion-prediction vectors – using only frame-internal references (for I-type frames); internal- and past-frame references (for P-type frames); or internal-, future- and past-frame references (for B-type frames). For the uninitiated, a frame is analogous to one of a sequence of still pictures, which in quick succession (for example, 24 to 30 per second) become motion video. It is common to use a repeating pattern of, for example, one I frame, followed by two B frames, followed by a few triplets of PBB, then repeating the entire pattern. The frames from one I frame to the next are called a group of pictures, or GOP, such as IBBPBBPBBPBB (followed by IBBPB…).

5.6 Redundancy in Moving Pictures – *Spatial and Temporal Dependence in MPEG.* MPEG *takes advantage of predictability* in the picture and in picture motion – also termed spatial and temporal redundancy – which MPEG vies temporarily to remove for transmission efficiency, then replace again, to recreate an accurate representation of the original. The higher the redundancy during a portion of a video program, the lower the bit rate required to represent it during that time. *The most efficient encoding yields a varying bit rate* inversely related to spatial and temporal redundancy.

Removing spatial and temporal redundancy *comes at the cost of creating spatial and temporal dependence* in the MPEG digital bitstream. An example of MPEG temporal dependence is that by design a frame encoded as B-type is insufficient to replicate the original unencoded frame (which it was intended to represent) without access to past and future reference frames (I and/or P). Therefore, editing and switching of MPEG is no longer as simple as it was with NTSC, PAL or component video. In fact, the more efficient the MPEG encoding, the longer the periods of bitstream interdependency (GOP lengths, between successive I-frames) and the more difficult the bitstream is to edit or switch. Spatial dependency similarly inhibits any editing which involves alteration or superposition of images.

5.7 Options within MPEG. There are categorical groupings for MPEG encoding regimes (termed Profiles and Levels) according to Figures 2 and 3 (adapted from reference i. – for an excellent review of MPEG, see Dr. Sikora's complete referenced article). The most popular MPEG application category for broadcasting is Main Profile at-Main Level, and includes 4:2:0 color resolution and up to full D1 luminance resolution at up to 15 Mbps – although actual data rates in use are generally below 7 Mbps.

FIGURE 2. UPPER BOUND OF PARAMETERS FOR EACH LEVEL OF MPEG

MPEG LEVEL	PARAMETERS
HIGH	1920 samples / line (horiz. samples) 1152 lines / frame (vertical samples) 60 frames per second (fps) 80 Megabits per second (Mbps)
HIGH 1440	1440 samples per line 1152 lines per frame 60 fps 60 Mbps
MAIN	720 samples per line 576 lines per frame 30 fps 15 Mbps
LOW	352 samples per line 288 lines per frame 30 fps 4 Mbps

MPEG deals differently with the different source types of film (film-mode MPEG encoding, suitable for 24 fps progressively scanned content), frame video (for video captured frame by frame), field video (for video captured field by field) and telecine video (for film converted to video). Use of film-mode encoding for field-format video sources wastes bits and yields an inefficient encoding. Noting this example, but thinking in general, it is important to match those particular MPEG implementation options best suited to a specific requirement (whether source material requirement or another requisite element of the application environment).

5.8 Multiplexing. Remember that the aim of digital representation for transmission is primarily to *reduce the transmission bandwidth and transmission equipment required per program, to implement automation*, and to *permit the transmission of adjunct data*. The primary issues for digital video multiplexing are that, (1) MPEG's most efficient representation of a program is a varying bit rate (equivalently variable bit rate, or VBR) representation with average bit-rate between 1 and 4 Mbps, and (2) most transmission channels are designed for constant bit rate (CBR) use at between 20 and 50 Mbps. The method employed to fit multiple VBR programs in a fixed CBR channel is termed *statistical multiplexing* (or *stat-muxing*). Stat-muxing multiple VBR MPEG-encoded programs into a CBR channel is necessary to reach the most efficient use of MPEG encoding for transmission.

implementation of an MPEG-based broadcast transmission structure that takes advantage of MPEG's rich feature-set for the entire range of possible source types and system configurations.

An easy but *inefficient* multiplexing solution is to employ a CBR allocation for each program. In this case, selection of CBR programs from among a CBR multiplex of one transmission segment for a different CBR multiplex grouping in a successive transmission segment is virtually unconstrained.

Alternatively, using the most *efficient* VBR MPEG digitally encoded representation with stat-muxing (inherently VBR) creates a *dependency* among the programs in the VBR multiplex, and selection of programs from one VBR multiplex for inclusion in a successive VBR multiplex requires further management of the second multiplex. This is called *statistical re-multiplexing*.

FIGURE 3. ALGORITHMS AND FUNCTIONALITIES SUPPORTED WITH EACH MPEG PROFILE

PROFILE	ALGORITHM
HIGH (the Advanced Television Systems Committee, ATSC, in the U.S. standardized U.S. HDTV as a subset of this profile)	Supports all functionality provided by the Spatial Scalable Profile plus the provision to support: I. 3 layers with the SNR and Spatial Scalable coding modes II. 4:2:2 YUV-representation for improved quality requirements
SPATIAL SCALABLE	Supports all functionality provided by the SNR Scalable Profile plus an algorithm for: I. spatial scalable coding (2 layers allowed) II. 4:0:0 YUV-representation
SNR SCALABLE	Supports all functionality provided by the Main Profile plus an algorithm for: I. SNR scalable coding (2 layers allowed) II. 4:2:0 YUV-representation
MAIN	Nonscalable coding algorithm supporting functionality for: I. coding interlaced video II. random access III. B-picture prediction modes IV. 4:2:0 YUV-representation
SIMPLE	Includes all functionality provided by the MAIN Profile but • does not support B-picture prediction modes • 4:2:0 YUV-representation

Early implementors of MPEG did not implement stat-muxing (they used CBR multiplexing in which each program was allocated a fixed bit rate), since they were happy to achieve a 5-fold transmission-cost reduction at the time, although 10 or even 20-something fold transmission cost reductions may be possible with stat-muxing (depending on other system parameters and quality desired).

The challenges of such stat-muxing come about because transmission requirements frequently involve *multiple transmission segments* (each of which may employ stat-muxing) and the *program multiplex groupings may change from transmission segment to transmission segment* and also from time to time. A related challenge is the uniform

Statistical remultiplexing is accomplished in one of two ways: either using MPEG VBR encoders to control the aggregate bit rate (*encoder-effected* stat-muxing), or using a new technique whereby the aggregate bit rate is controlled within the multiplexer itself (such as with a *recoding* multiplexer).

5.9 *Encoder-effected* Statistical Multiplexing. Current stat-mux implementations either employ feedback from the multiplexer to the encoder for each program making up the multiplex or employ a control circuit among these encoders to effect the statistical multiplex. In either case a useful and descriptive term for this type of statistical multiplexer is an *encoder-effected* stat-mux. In the instance of remultiplexing, *encoder-effected* statistical multiplexers require decoding of incoming multiplexes so that a set of VBR encoders all working together can constrain the maximum aggregate bit rate to the channel capacity. In fact you could call an *encoder-effected* stat-mux an *encoder-constrained* stat-mux since all of the encoders must be colocated (generally next to the multiplexer). One downside of this approach is that a second MPEG encoding must be performed; and in all current implementations, this second encoding involves further erosion of video quality, called generational loss (some estimate that a single regeneration causes a 30% quality reduction). Other downsides of this approach are that all of the encoders and multiplexers must be from the same manufacturer, and many additional encoders and decoders are required.

5.10 *Recoding* Statistical Multiplexing. An alternative approach is a stand-alone VBR multiplexer/remultiplexer, which manages the aggregate bit-rate by making quantization adjustments in the multiplexer itself, without decoding the MPEG program (a *recoding multiplexer* – such as the CherryPicker™ currently being developed by Imedia). This approach avoids generational loss, and also avoids the additional decoders and encoders needed in the *encoder-effected* approach to statistical remultiplexing. By working autonomously of any encoders, a *recoding multiplexer* permits locally and remotely encoded sources selected from among any type of prior multiplexes to be efficiently combined in a new *highly-efficient* statistical multiplex, including local advertisements or Digital Versatile Disk (DVD).

5.11 Adjunct Data. An additional benefit of the *recoding* multiplexer approach is that with free running VBR encoded programs being combined by a *recoding* multiplexer, there will be occasional space left over for latency-insensitive adjunct data. It is our understanding that no such statistically spare space is available for adjunct data when an encoder-effected statistical multiplexer is used, since it seeks to fill the entire multiplex capacity with video.

5.12 Channel Coding and Modulation. The last two parts of the digital transmission preparation process are *channel coding* and *modulation*, which are closely related, and sometimes are one-and-the-same function. *Channel coding* vies to minimize channel transmission errors by using error-correction and error-detection algorithms, and *modulation* is the method of putting bits on a channel.

In order to work with the low signal-to-noise ratios of satellite channels, *satellite broadcasters* typically use QPSK (Quadrature-Phase-Shift-Keying) modulation achieving a bits (per second) per Hertz of a little less than 2. *Terrestrial digital television broadcasters* in Europe plan to use Coded Orthogonal Frequency Division Multiplexing (CO-FDM) and in the U.S., 8-Vestigial Side-Band (8-VSB) both at about 4 bits/sec./Hz. *Cable broadcasters* (i.e. cable system operators) are expected to use one of the more efficient 64 or 256-QAM (Quadrature Amplitude Modulation) at about 6 or 8 bits/sec./Hz., or perhaps 16-VSB at about 8 bits/sec./Hz (implementation inefficiencies practically reduce these integer factors by 10 to 30%). This means that *cable & terrestrial* channels can carry about 2 to 4 times the number of digital TV programs as *satellites* on similar bandwidth channels.

A coarse rule-of-thumb is that cable & terrestrial can carry the same number of channels in their 6 or 8 MHz as in a 20+ MHz satellite transponder channel. Of course, the lower modulation efficiency of satellites is counter-balanced by their continental reach – which is not available via cable or terrestrial broadcast.

6. CHARACTERISTICS OF MPEG DIGITAL VIDEO

What is good performance when it comes to *sampling, digitizing, source encoding, multiplexing, channel coding* and *modulation*? *Analog* video broadcast quality is measured in a convenient continuous scale with simple values like 54 dB signal-to-noise ratio; unfortunately, there is no comparable measure for *digital* video quality.

Only subjective standards are uniformly agreed to be adequate to fully characterize performance of video source encoding and multiplexing. So we always ask, *"how does the resulting picture look?"* This will be the test for the foreseeable future, even though more and more test equipment is becoming available to quantify MPEG-2 parameters in useful ways.

A common way to characterize MPEG-2 encoding performance is to associate a described video quality (for example, "broadcast quality") with a certain bit rate. However, some content (e.g. sports) requires more bits for adequate representation than other less-complex content, and MPEG-2 encoder performance varies among manufacturers – due to variations in MPEG encoding implementations and the complex nature of MPEG.

Francois Fluckiger, deputy head of networking at CERN (the research institute where the World Wide Web was born) shows digital video Quality vs. Bit Rate without statistical multiplexing (included here as the first four columns of Figure 4) in his book, "Understanding Networked Multimedia". In these first four columns, Dr. Fluckiger solely addresses the issue of source encoding, not statistical multiplexing. The bit rates listed in columns 3 and 4 of Table 1 are *constant-bit-rate* (CBR) values (no statistical multiplexing). Broadcast experts may not yet agree on the actual preferred constant-bit-rates for various quality levels – and Dr. Fluckinger's CBR estimates in column 4 of Table 1 are aggressive (except for HDTV) – but it is useful to have someone's numbers as a reference point.

With CBR MPEG, the bit rate is constant, while picture quality varies inversely with picture complexity; whereas VBR MPEG aims for constant video quality – as picture complexity varies, so does the bit rate to maintain more uniform picture quality. When employing the more efficient *statistical multiplexing* using VBR, the preferred average bit-rates of Figure 4 will be noticeably reduced. Typical average bit-rates anticipated for VBR stat-muxed TV programs are shown in the last column of Figure 4. Of course the performance of a single VBR program in a multiplex is related to the entire statistics of the multiplex, including the number of programs in the multiplex.

6.1 Optimal MPEG. Primary pre-requisites for efficient use of MPEG can be summarized as the use of *VBR encoding* and *VBR statistical multiplexing* – with *infrequent I frames*. Explanations follow, including constraints for each pre-requisite.

6.2 VBR encoding. Just as your mouth buffers the liquid entering your throat when drinking from a cup while experiencing a bumpy ride in a vehicle, so the decoder video buffer buffers the varying number of program bits parsed from a CBR transport stream (the video stream formed by *multiplexing/remultiplexing* multiple VBR programs). If you suddenly switch from one cup to another (analogy to switching between MPEG bit streams) and both cups (programs) happen to be gushing at that time, your mouth can not accommodate the onslaught and some of the liquid is lost (buffer overflow). The solution for the analogous MPEG VBR transmission switching problem is always to know about the decoder buffer status and to be able to adjust program bit streams to prevent overflow or underflow conditions. Buffer management is required whenever using VBR.

6.3 VBR multiplexing. Much has already been said about multiplexing. The initial consequences can be summarized that bit rate and bit stream management is required to manage multiplex and decoder buffer constraints; and that the best technique for such management avoids generational loss by effecting program bit rate control within the multiplexer – independent of any MPEG encoders.

6.4 Infrequent I frames. Since I frames are entirely self-constructed, they form a convenient reference point in the MPEG bitstream for switching (assuming closed GOPs, which means that I frames are only used for forward prediction, and consequently that GOPs are independent). Self-constructed frames (I frames) have significantly higher bit rate representations than predicted frames (P and B) by a

FIGURE 4. QUALITY VERSUS BIT-RATE

Quality 1	**Technique or standard** 2	**Unencoded Mbps (CBR)** 3	**Encoded Mbps (CBR)** 4	**Encoded Mbps (VBR)** 5
HDTV 1920x1080/60 fps				
Uncompressed		2000	--	--
Compressed	MPEG-2	--	25 to 34	10 to 15
Studio-Quality digital TV				
Uncompressed	ITU-R 601	166	--	--
Compressed	MPEG-2	--	3 to 6	2 to 5
Broadcast-quality TV	MPEG-2	--	2 to 4*	1.5 to 3**
VCR quality	MPEG-1	--	1.2	1.0
Videoconferencing	H.261	--	0.1	0.05

*4 Mbps and **2 Mbps will be used for subsequent examples in this paper as *strawman* representative figures for CBR vs. VBR encoding and multiplexing.

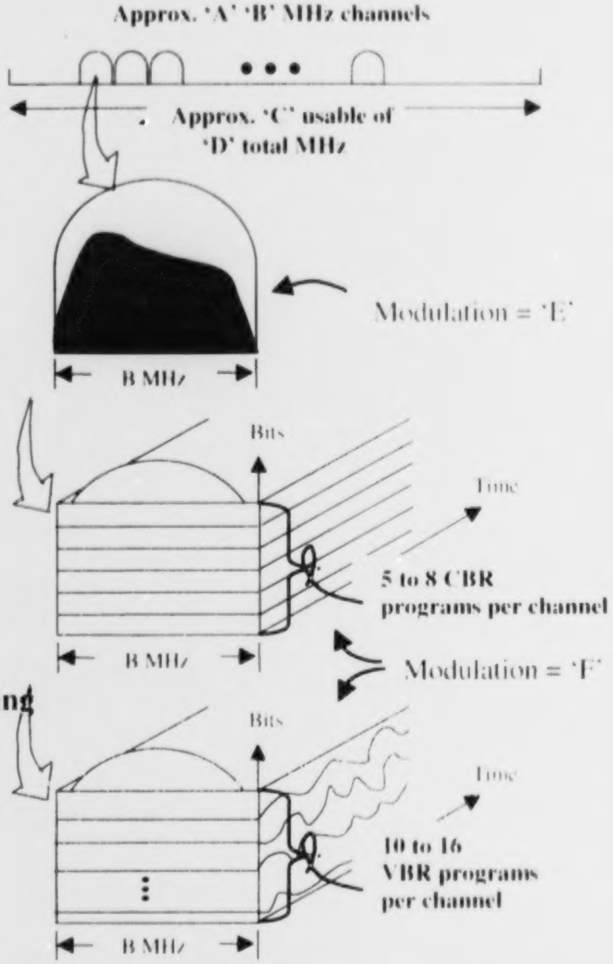
Figure 5. CBR Multiplexing vs. Statistical Multiplexing for Cable, Satellite, and Terrestrial

	No. Channels 'A'	Channel Bandwidth (MHz) 'B'	Usable Bandwidth (MHz) 'C'	Total Bandwidth Available 'D'	Analog Modulation 'E'	Digital Modulation 'F'	Typical Aggregate Capacity (Mbps)
Cable	70	6*	400	450	AM - VSB	64 - QAM	2100
Satellite	32	20+	700	1000**	Analog FM	QPSK	96
Terrestrial	10	6*	60	60	AM - VSB	8 - VSB***	20

*NTSC, PAL is 8

**with 2X freq. reuse

***or CO-FDM



Approx. 'A' 'B' MHz channels
Approx. 'C' usable of 'D' total MHz
Modulation = 'E'
B MHz
Bits
Time
5 to 8 CBR programs per channel
B MHz
Modulation = 'F'
Bits
Time
10 to 16 VBR programs per channel
B MHz

Old Analog Method

	CAPACITY in No. Programs
CABLE	70
SATELLITE	32
TERRESTRIAL	10

CBR Multiplexing @ 4 Mbps

	CAPACITY in No. Programs
CABLE	525
SATELLITE	240
TERRESTRIAL	50

VBR Statistical Multiplexing @ 2 Mbps average

	CAPACITY in No. Programs
CABLE	1050
SATELLITE	480
TERRESTRIAL	100

CAPACITY IN NO. PROGRAMS = NO. OF CHANNELS X NO. OF PROGRAMS PER CHANNEL

(Parameters are Chosen for Example Comparison Only – Significant Variations Exist) factor of as much as 10 or so (900% or so more bits). Therefore, it is clear that it is desirable to use I frames sparingly to lower the bit rate, while still targeting the same high picture quality. Each P or B frame between successive I frames is dependent – in general – on another frame (I or P, or both), sacrificing bit stream independence.

The constraints associated with these efficiency-prerequisites are the need for special advanced *multiplexing*, *remultiplexing*, and *switching* techniques to achieve superior (generationally lossless and low average bit rate per program) digital transmission and switching.

6.5 Program Capacity For Cable, Terrestrial, And Satellite. The implications of statistical multiplexing on program capacity performance vary according to transmission channel type: cable, satellite, terrestrial, or other. Figure 5 shows the comparative difference in number of possible TV programs using CBR encoding, token-multiplexing (simple combining) & transmission – versus VBR encoding, stat-muxing & transmission – are shown for cable, broadcast terrestrial television, and satellite. The system parameters will vary significantly from one instance to the next. For example, cable system bandwidths range from 350 to 950 MHz or more, with common capacities between 450 and 750 MHz.

Stat-muxing yields a significant increase in the number of programs possible on a channel. Increasing the number of programs is only one of the options and implications of much higher channel transmission efficiency. Another clear implication is a reduction in the need (and related expense) for channel transmission equipment – since fewer channels are required to transmit the same number of TV programs. Improving video quality or adding adjunct data services (for example Internet) are still other valuable options.

Now that we have reviewed the key performance advantages of digital video, and the key parameters which are involved, we will look at specific issues for broadcasting archived and live content.

7. IMPORTANT CASES: ORIGINATION, RETRANSMISSION, AND SWITCHING.

In order to visualize the broadcast requirements that need special handling in MPEG, refer to the general broadcast diagram of Figure 6.

7.1 Efficient Storage & Origination of Archived Content. Going from left to right in Figure 6, content originates at: the news van, prerecorded content originates at the studio (live news from contribution satellites does not originate here), and local programs & advertisements originate at the three redistribution sights – for satellite, terrestrial, and cable (programs received from distribution satellites do not originate here). Unless the origination is live (as in the case with news origination), the content is played out from a storage device.

The main goal of program storage (or archiving) is maintaining quality for subsequent use (editing or broadcast *origination*) at reasonable cost and operational convenience, including the cost of space. The future is expected to involve much more digital storage, as costs inevitably come down, and as capacity increases. But what digital video format is suitable for storage in the new multiprogram TV environment: uncompressed, lightly compressed, or highly compressed? Of course, each fills a different role.

After recognizing the transmission efficiencies of MPEG VBR encoding followed by stat-muxing, many broadcasters are currently investigating converting their analog archives to MPEG VBR storage, so that the digital format is ready for efficient transmission. Imedia has introduced the first media asset management system that encodes and stores programs in MPEG VBR, and assembles them (via software) in a statistical multiplex for efficient playout. This system focuses on efficient storage for transmission, saving cost in both storage equipment and transmission equipment (for example, expensive satellite transponders).

Applications include pay-per-view, near-video-on-demand, or other pre-recorded content storage and distribution, including pre-recorded interstitials (e.g., advertisements).

7.2 Efficient Transmission Of Live Content. Ideal live digital television transmission involves only encoding once. Once encoded, a television program ideally propagates error free – via channel coding which corrects errors – through a variety of possible channels, including multiplexing and remultiplexing as in Figure 6. MPEG makes necessary compromises to achieve this ideal goal. These compromises are best understood in light of the associated constraints.

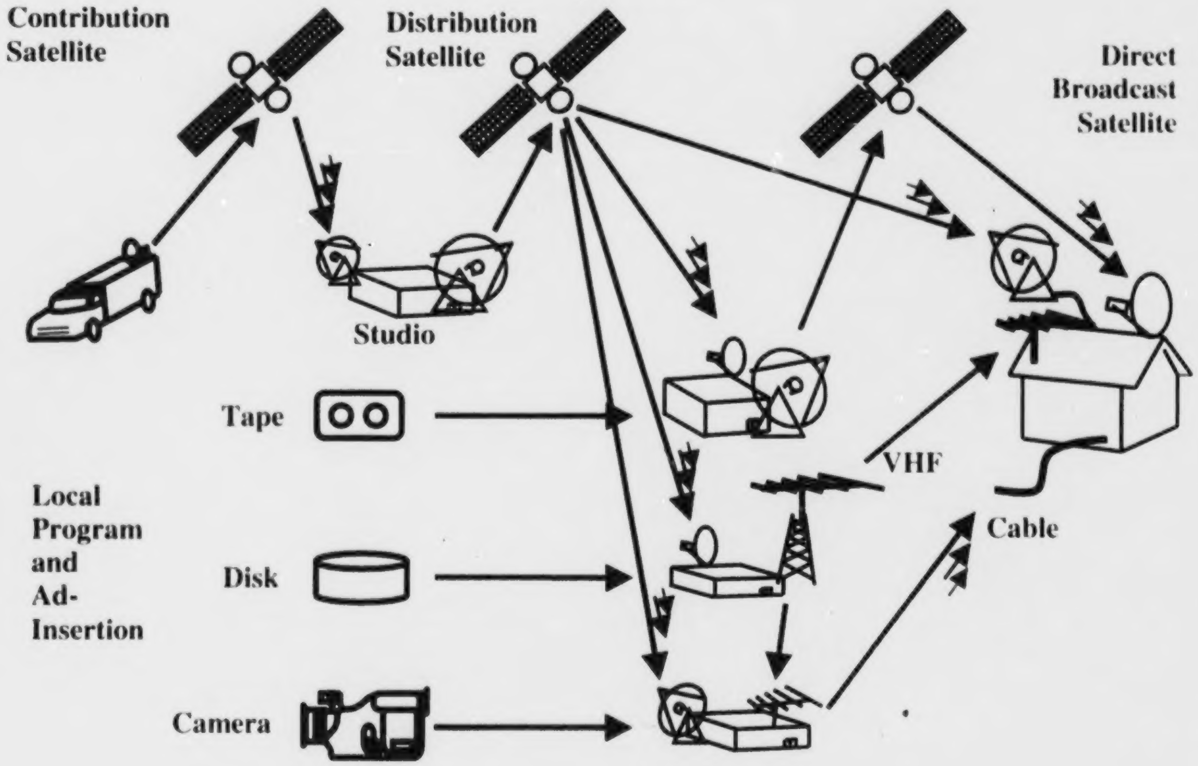
Efficient-MPEG prerequisites resummarized are VBR encoding and VBR multiplexing with infrequent I frames. The constraints resummarized are special multiplexing, remultiplexing, and switching techniques – including buffer management and *recoding* multiplexing (to maintain high-efficiency remultiplexing without generational loss).

MPEG has been implemented with suboptimal efficiency (better efficiency than analog, but less than what MPEG permits) via constant bit-rate (CBR) encoding and with frequent I frames to facilitate *multiplexing*, *remultiplexing*, and *switching*. Up to now, suboptimally-efficent MPEG (using CBR with frequent I frames) has been the only practical option for *switching* MPEG; and, with the exception of *encoder-effected statistical multiplexing* (which has its own additional constraints), also for MPEG *multiplexing and remultiplexing*.

7.3 Grooming Digital Multiplexes – Also Known As Cherrypicking. Efficient grooming requires an advanced technique for *multiplexing/remultiplexing*. Grooming means the selection of desired programs from among various distribution multiplexes for remultiplexing into new downstream multiplexes for further broadcast or distribution. The terms grooming, cherry picking, and remultiplexing (or remuxing) are interchangeable.

7.4 Bit Rate Adjustments. If bit rate adjustments become necessary, they must be done carefully to minimize perceptible video quality loss. At the same time, decoder buffer conditions must be tracked to avoid over- & underflow conditions which translate to frame-skipping or frame-freezing (or perhaps worse).

FIGURE 6.



As discussed earlier, efficient *multiplexing* (or *remultiplexing*) is variable-bite-rate and statistical. *Statistical multiplexing* relies on the ability to adjust program bit rates. In divvying up the bit-rate of an MPEG transport stream one should look in every possible dimension to load it efficiently.

By tracking the decoder buffer status, an advanced statistical multiplexer can delay or advance the transmission of bits from one program relative to those of another to avoid coinciding bit rate peaks. If during some period the sharing-of-program-space and the-adjusting-of-bits-in-time are insufficient to keep the instantaneous bit-rate below the channel capacity, the bit-rate must be adjusted for some or all programs in the multiplex. Ideally, such bit-rate adjustments will yield graceful and minimal degradation to video-quality.

Lossy bit-rate reduction may be accomplished by fully decoding the MPEG program to uncompressed digital or analog (the pixel level), followed by an additional reduced-bit-rate MPEG encoding of the program (the way current *encoder-effected statistical multiplexers* accommodate remotely encoded sources). This is undesirable since it results in generational-quality-loss (continuous quality loss). Alternatively, a *recoding* (re)multiplexer avoids generational loss by adjusting the bit rates internal to the multiplexer (without decoding to the pixel level) only as a last resort to meet the multiplex bit-rate constraint (infrequent quality loss only as a last resort).

A common example application is satellite distribution of a statistical multiplex to cable head-ends (or terrestrial broadcast network affiliate stations) followed by a different statistical multiplex formed in the headend (with one or more programs from the first statistical multiplex) to the viewer. If efficient grooming with a *recoding (re)multiplexer* is employed, then the program quality is minimally reduced only at the *recoding* points. On the other hand, if the program is fully decoded to the pixel level then re-encoded using one of today's *encoder-effected statistical multiplexers*, the quality will be continuously degraded.

Summarizing, a *recoding*(re)multiplexer accepts encoded bit streams and accommodates remotely encoded programs at high efficiency and without generational loss. On the other hand an *encoder-effected* statistical remultiplexer regenerates (decodes and then re-encodes) the video thus introducing generational loss.

7.5 Digital Ad-Insertion and MPEG Switching. Both digital ad-insertion and local program insertion into MPEG bit streams require switching of the MPEG bit stream. The issues for *switching* MPEG are the *temporal interdependency* of the MPEG bit streams, variations in buffer and clock states between the two signals to be switched, and *remultiplexing* the newly constituted multiplex.

Remultiplexing is required since the introduction of a different bit stream in a statistical multiplex may invalidate the original multiplex coordination (exceeding the channel bit rate). Therefore any solution of the switching problem requires a solution to the *statistical remultiplexing* problem (preferably using a *recoding* multiplexer since it avoids generational losses). Thus, the following two solutions are required for MPEG switching: (1) bit-rate and bit-stream management to manage multiplex and decoder buffer constraints, and (2) bit-stream temporal-dependency management. The first of the two is necessary for *statistical multiplexing/remultiplexing* and both are required for switching.

Different approaches to dealing with temporal dependency involve either accommodating it or temporarily removing it around the switch point. The goal is minimal quality degradation and flexible switching. Depending on the application, flexible switching may mean switching at the nearest I frame (which is largely why I frames exist), or at an arbitrary frame (which is possible, but more difficult to accomplish smoothly).

Since a decoder has to wait for an I frame to begin constructing a new program which it has begun to receive, the inserted program will always begin with an I frame. A terminating program may be terminated just before transmission of either an I or a P frame. The simplest switching technique involves buffering both streams enough to introduce them to one another at such appropriate switching points.

It is important to emphasize that the problems of *switching* and *multiplexing* are related and require a common solution.

7.6 Digital Editing. *Editing* may range from simple switching to performing cross-fades and wipes, introducing logos or even warping images. Simple *switching* has already been discussed. The other editing operations – cross-fades, wipes, logo-introduction, warping, etc. – are generally not possible in the MPEG compressed domain and require full decoding to the pixel level before the edit followed by re-encoding after the edit. There is a preferred way to fully decode for editing that minimizes generational losses. Generational losses are minimized when the original encoding decisions are replicated during re-encoding to the extent possible.

8. CONCLUSION.

The efficiency (quality, quantity, and cost) of current implementations of MPEG-digital-broadcasting are limited by the use of: *constant*-bit-rate encoding, *frequent* I frames, *constant*-bit-rate multiplexing, or *encoder-effected* statistical multiplexing.

Advanced techniques, including a *recoding m*ultiplexer, are currently being developed by Imedia for introduction in 1998 with none of these limitations. The advanced techniques will allow digitally encoded transmissions from source to destination, including grooming of incoming multipexes, MPEG-switching for ad-insertion or local-program insertion, and multiplexing of latency-insensitive adjunct data without the current compromises of regenerational loss, bandwidth inefficiency, or single-vendor compatibility. These techniques include novel transformation of an encoded bit-stream bit-rate, and novel statistical multiplexing – and address the most challenging implementation areas (encoding and multiplexing) for a digital video transmission system.

Together with educated and discriminating choices regarding other parts of a digital video transmission system (e.g. sampling, digitizing, channel coding, modulating, storing, automating) an optimum implementation can be realized.

References

[i] T. Sikora, "MPEG Digital Video-Coding Standards," *IEEE Signal Processing Magazine*, Vol. 14, No. 5, pp. 82-100, Sept. 1997

[ii] B. G. Haskell, A. Puri, and A. N. Netravali, "Digital Video: An Introduction to MPEG-2," International Thompson Publishing, 1997.

[iii] J. L. Mitchell, W. B. Pennebaker, C. E. Fogg, and D. J. Legall, "MPEG Video Compression Standard," International Thompson Publishing, 1997.

[iv] F. Fluckiger, "Understanding Networked Multimedia," Prentice Hall, 1995.

ALOHA TO THE WEB

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1. ABSTRACT

Wireless access to the Web at the end of the 20th century is slow, unreliable, and expensive. In this paper we provide an overview of wireless Internet access, emphasizing four basic architectural features of networks which must be addressed before wireless data can achieve the levels of acceptability achieved by wireless voice.

These features are (1) a client server architecture (2) asymmetric data rates (3) connection free operation and (4) wideband performance. Conventional ALOHA channels address the first three of these architectural features and ALOHA channels are commonly used for web access. But in a wireless setting such channels lack the wideband capabilities demanded by today's users. Spread ALOHA Multiple Access (SAMA) combines the proven simplicity and operational flexibility of an ALOHA multiple access channel with the high bandwidth and high throughput of a Spread Spectrum channel.

2. INTRODUCTION

Wireless access to the Web at the end of the 20th century is slow, unreliable, and expensive. ARDIS, Mobitex and CDPD each employs a variant of a conventional ALOHA channel to provide a nominal 10 kbs to 20kbs network. The useful data rate delivered to the end user is well below 10 kbs for the same reason that a 10 Mbs Ethernet delivers much less than 10 Mbs. In addition the symmetric channels employed by these data services are derived from a voice traffic model which seems ill suited to the highly asymmetric traffic generated by today's Web surfer.

Asymmetric broadcast data channels offered by DirecPC and DirecDuo provide a nominal 400 kbs to the user but require an awkward telephone connection for the reverse multiple access link from the user. Similar multiple access limitations arise in the use of wired cable modems for data.

In this talk we provide an overview of wireless Internet access, emphasizing four basic architectural features of networks which must be addressed before wireless data can achieve the levels of acceptability achieved by wireless voice.

3. WIRELESS ARCHITECTURE

The first of these architectural features is that of topology. Although some networks are based upon a peer-to-peer RF architecture, most networks are based upon a client-server architecture in order to obtain significant RF link advantages in both directions and in order to better match the logic of most user applications.

A second key architectural feature of wireless data networks, asymmetry, is related to the client-server decision but is also closely connected to the basic data rate asymmetry of most network applications. It is perhaps not surprising that surfing the Web and many data base applications provide highly asymmetric data rate requirements for the network. But it is often not appreciated that many other important applications such as Email and teleconferencing exhibit similar asymmetries.

The third architectural feature discussed in this talk deals with the advantages of putting aside the two way voice paradigm of a connection oriented service. In a connection oriented service a connection is established between the transmitter and the intended receiver before useful information is sent. The connection oriented service establishes a minimal value of latency for the transmission of packets in a packet network and dedicates a full time channel resource to a transmitter which may require only intermittent use of that resource. A connection free access architecture, such as used in Alohanet, Ethernet or the IP portion of the Internet TCP/IP protocols can provide zero latency and high efficiency in the use of shared channel resources for bursty data.

The last feature required for truly pervasive wireless access to the Web is that of wideband operation. Conventional first generation ALOHA channels and their derivatives are all based upon a connection free, asymmetric client-server architecture, but in the wireless context they are condemned to narrowband operation for the same transmit power reasons which restrict TDMA architectures.

4. WIDEBAND WIRELESS TO THE WEB

Spread ALOHA Multiple Access (SAMA) eliminates the restriction to narrowband channels required by first generation ALOHA protocols. SAMA is a second generation version of the classical ALOHA protocols which can provide the wideband multiple access capabilities required for the applications of today. SAMA combines the proven simplicity and operational flexibility of an ALOHA multiple access channel with the high bandwidth and high throughput of a Spread Spectrum channel.

How Telcos Can Make Money With The Internet

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Cisco Systems, Inc.
San Jose, California, USA

1. ABSTRACT

Traditional telephone companies worldwide have been relatively slow to get into Internet services perhaps due to a feeling that the Internet is mainly for computer hobbyists. While this may once have been true, businesses today are finding the Internet to be a key tool in selling new customers, in delivering quality customer service, and in managing operations costs.

But can the Internet be good business for a small or medium size telco around the Pacific Rim? In this paper, the author draws upon experiences with hundreds of telcos and ISPs around the world to identify the strategies and critical success factors for a telco to succeed with the Internet.

2.0 The Amazing Internet

The Internet is rapidly becoming one of the most amazing phenomenon of the 20th century, and may well hold that honor long into the next. Enterprises of all types now use telecom services to gain a competitive advantage, and carriers that offer Internet-based services tailored to that end will grow revenues and market share. But many traditional telephone companies have been slow to embrace this revolution, or at least with much enthusiasm. Perhaps it's a feeling the Internet is mainly for computer hobbyists, far from the more familiar voice services. Or telcos, often run by managers with a long-term view, may be thinking the Internet is just a fad, and will quickly fade away. What ever the reasons, it's interesting to see the leading telecom companies worldwide, with a few exceptions, do not seem to be leading the Internet movement, but either bringing up the rear or, in some cases, watching from the sidelines.

In this paper, the basis for the rapid growth of the Internet will quickly be covered, along with the factors that will control its future success. The reasons the Internet is a good business opportunity for a Pacific Rim telco, what decisions are required, and examples of services to offer will be explored.

Figures 1, 2, and 3 offer a quick view of the growth of the Internet, past and future. The amazing growth in users is shown, along with forecasts of two key applications, Internet voice traffic and Internet-based electronic commerce.

3.0 But How Far Can It Grow ?

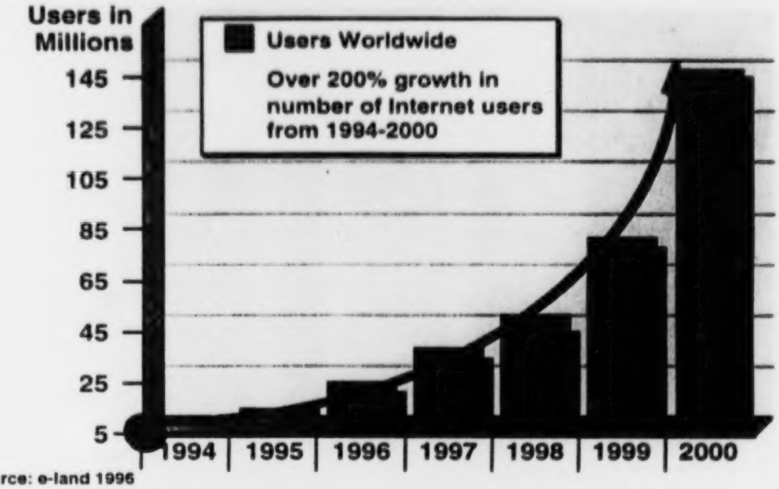
There are several reasons why the Internet is not merely a new technology fad, but rather is a fundamental change in business communications. Much like the telephone networks revolutionized business in the days of the telegraph and messenger, the Internet is starting to have this effect today.

The Internet began as a tool for university researchers, and then became almost a hobby for university students and others in the computer field. But with the invention of the World Wide Web, the Internet added a new dimension, more akin to a worldwide library of information than to a private messaging system. When most business people today speak of the Internet, they actually have the World Wide Web in mind, as it has rapidly become the part of the Internet that most people are familiar with.

So why is the Internet *not* just a fad? There are three major reasons: the emergence of high-value business applications, the development of intranets within large companies and organizations, and the emergence of various vested interests.

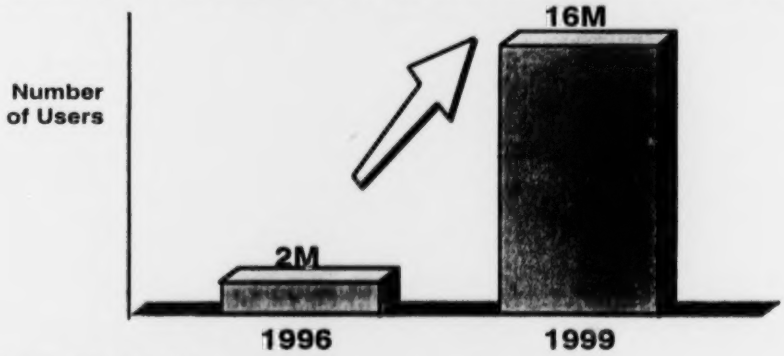
Electronic mail between employees, once a convenience, is increasingly valuable. But increasingly, companies are moving to put business-critical applications on the Internet. A recent example is NEC, the Japanese electronics giant. NEC has several hundred key suppliers around the world, and has announced that it will move all purchasing to the Internet. Naturally when a company puts purchase orders, shipping notices, invoices, and such on the Internet, they are making a strong commitment. And NEC is only one such example. Many people are aware that catalog sales companies like LL Bean do lots of business over the Internet, and new companies, such as book-seller Amazon.com, have sprung up that do business *only* on the Internet. As another example, Cisco Systems did over US$2 billion dollars worth of business over the Internet, amounting to almost 1/3 of its total sales.

Figure 1: INTERNET USERS AND GROWTH



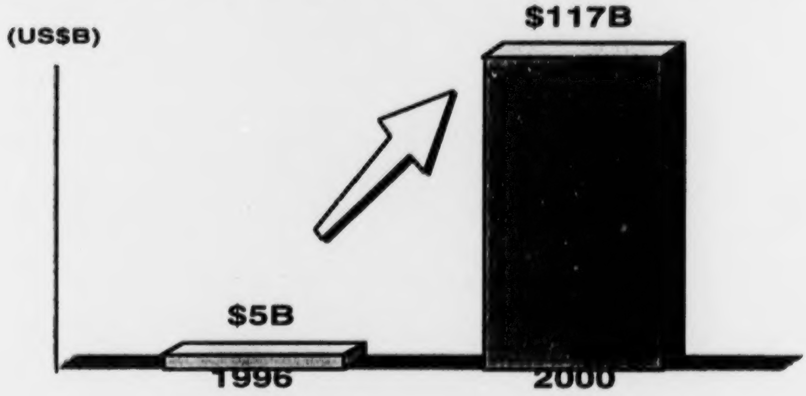
Source: e-land 1996

Figure 2: IDC 1996 FORECAST OF INTERNET VOICE SERVICES USERS



Source: IDC/LINK 1996

Figure 3: IDC 1996 FORECAST OF ELECTRONIC COMMERCE



A second reason to believe the Internet is here to stay in the rapid emergence of Intranets. These are the internal corporate networks of old, but built using Internet technologies. As shown in Figure 4, a significant reason for this growth is the ability, using Internet standards such as TCP/IP and HTTP, for *any* type of desktop system, be it PC, Mac, UNIX, etc. to access information on *any* type of host system, be it a UNIX minicomputer, an IBM mainframe running MVS, a NT-based server, or indeed, just another PC.

The last reason we can mention for the Internet's future is that various major players are putting a lot of money behind it. It wasn't long ago that Microsoft didn't have any Internet products or interest, but today, Bill Gates and his colleagues have gotten inspired, turning most of the development work at Microsoft towards the Internet. This type of big-budget support practically guarantees the Internet will keep growing.

4.0 The Key Decisions You Must Make

Getting into the Internet in some way seems practically a requirement for local telcos. Traditional services are increasingly coming under competitive attack, and pressures on governments and regulators are keeping pressure on budgets. There are several key strategy questions to answer at the beginning, however. As shown in Figure 5, a telco needs to decide both which customers to target, and exactly what services to offer to each. Based on the experiences of telcos so far with the Internet and other data-oriented services, in general the easiest service to deliver is to just sell bandwidth to small Internet Service Providers (ISPs). This is the course of action generally being taken by Cable & Wireless, for example. At the other extreme, providing services to the residential market will prove to be the hardest, with 'easiest' and 'hardest' meaning both in terms of telco resources and staff training as well as in terms of likelihood of having a profitable service.

Selling transmission facilities and bandwidth to ISPs requires little effort, but reduces the customer contact the telco has. At the other extreme, providing complex services to very cost-sensitive residential customers is sufficiently difficult that some large ISPs in the U.S. have completely abandoned this market.

Larger business customers typically are looking for total solutions, which may well include international services, and they often have a technical staff that can address implementation matters. The Medium/Small business market, on the other hand, often lacks an understanding of the benefits and technologies of the Internet, much less any staff to evaluate such things. Taken together, these points stress the importance of a telco clearly deciding exactly what its Internet strategy will be, who the targeted customers are, etc.

5.0 The Greatest Business Opportunity Ever

So while the Internet is clearly a good game to be in, choosing exactly how is a little tougher. While major businesses will be attractive customers, it is also the area where a local telco can expect the greatest competition. The author believes the Medium/Small Business market has tremendous potential for local telcos, and that a major part of Internet resources should be directed there. The local telco is well known to local businesses from many years of providing PSTN services. This relationship is something to build upon, since neither start-up ISPs or global telecom companies typically have this.

Another factor supporting this market segment as ideal for telcos and service providers is the lack of knowledge among these customers. Gartner Group recently conducted a study of business firms and asked if they were connected to the Internet, and if not, when they planned to be. Figure 6 shows the results, comparing three different sizes of companies.

You would expect larger companies to be further along in making use of the Internet than smaller firms, but the reasons *why* may be surprising, and point to a great Service Provider business opportunity. The medium and small businesses that had *no* plans to connect to the Internet were asked why. The results are shown in Figure 7, and illustrate that these companies see their biggest problem not as cost or security issues, which might have been guessed, but simply a need for advice and turn-key solutions. And there is no one better positioned than the local telco to supply just that.

Looking beyond the Internet, the trend among many businesses is to outsource more and more applications to a trusted partner. Most often this is because the technical complexity and management responsibilities associated with integrated mission-critical systems and networks is growing more and more difficult for companies to handle.

6.0 Differentiating From Competitors

Services are the key to success in a market like the Internet. Just providing access to the Internet provides little differentiation, as other companies can provide an essentially identical service, sometimes at a lower price. One successful technique is to bundle services in ways that competitors will find difficult or impossible. For example, offering packages consisting of some PSTN services and some Internet services, at an attractive, all-in price, provides immediate differentiation, since the PSTN services are not something others can usually offer. And this approach also builds upon the reputation of the local telco as the provider of voice services.

But as the value of the service increases, the telco will find itself in an even more favorable position. For example, margins are generally much better on highly

Figure 4: INTERNET STANDARDS FOR ANY TO ANY NETWORKING

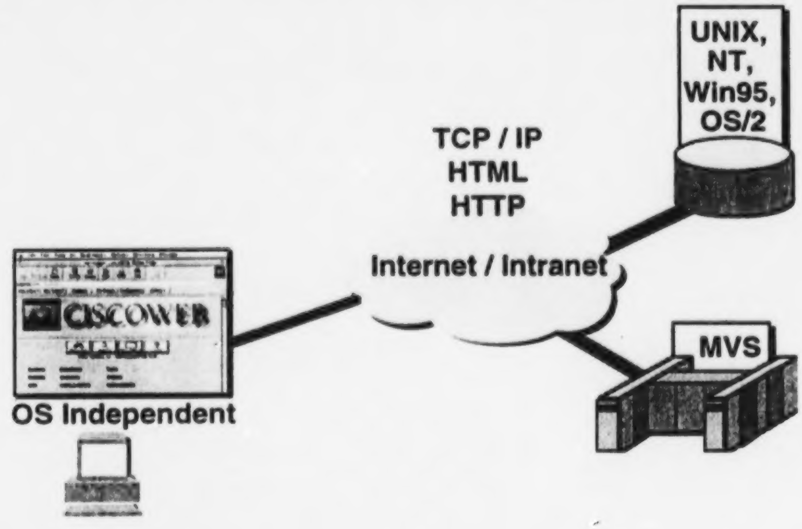
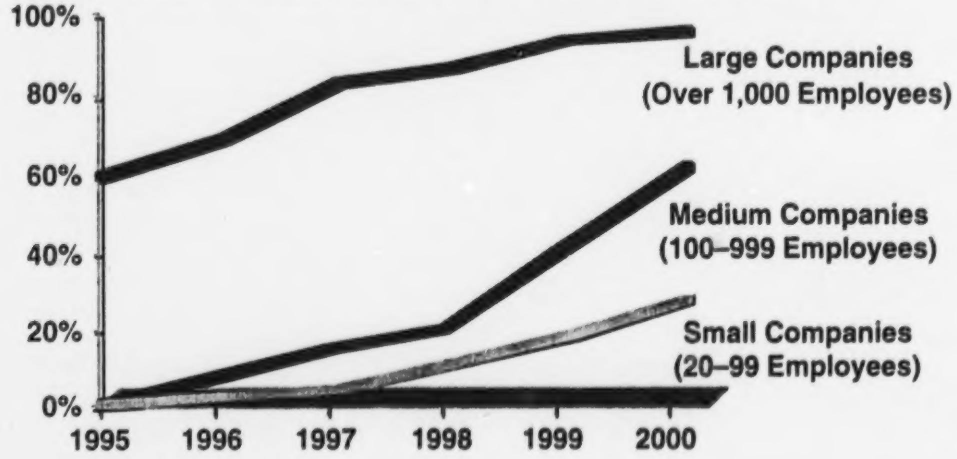

UNIX,
NT,
Win95,
OS/2
TCP / IP
HTML
HTTP
Internet / Intranet
CISCOWEB
MVS
OS Independent

Figure 5: SERVICES VS. MARKET SEGMENTS

V Services / Customers >	ISPs	Lg. Business	Med/Small Business	Residential
Security services	?	?	?	**Hardest**
Integrated voice / data services	?	?	?	?
Managed network services	?	?	?	?
Network-based Web caching	?	N/A	N/A	N/A
Web hosting	?	?	?	?
Dedicated Access	N/A	?	?	?
ISDN Dial Access	N/A	?	?	?
PSTN Dial Access	N/A	?	?	?
Wholesale bandwidth	**Easiest**	N/A	N/A	N/A

Figure 6: WHEN WILL YOU BE CONNECTED TO THE INTERNET ?



differentiated services. The Yankee group has studied the current and forecasted revenues for providing access to business and residential customers, and those from providing value-added services, and finds the business opportunity for the value-added services to be the fastest growing. See Figure 8.

Picking certain industries or markets, depending upon local circumstances, is another consideration. Generally, business-to-business transactions over the Internet will be more popular than business-to-consumer applications, at least in the near term. For example, the electronics and computer industries tend to be 'early adopters,' and the travel industry serves many customers who may be short of time (and thus seeking convenience) as well as have money to spend.

Regardless of the exact set of services chosen, telcos need to take an aggressive stance, since new ISPs and other new carriers are eager to attract important business customers away from the traditional telephone company. Depending upon the particular regulatory schemes in effect, these new entrants may be using marketing programs and product strategies proven in other markets to gain the attention of monopoly customers who are not used to having choices of service providers.

7.0 Example Value-Added Services

Services ISPs can offer that offer added value to their customers usually fall into the categories of Web hosting, security services, and managed access services (such as remote access and extranet services).

Web Server Hosting: A Service Definition

Web server hosting simply means putting the computer and its database at the ISP rather than at the end user customer. Not only does this relieve the customer of selecting equipment, training staff, etc., but it usually results in higher performance as well, since it eliminates the terminating facility or loop from the ISP to the customer site. An ISP offering a competitive Web server hosting service will stress high performance, high throughput, comprehensive security, 24 hour service, a wide variety of supported database applications, and perhaps even consulting services.

The ISP that offers Web server hosting will often have multiple Web servers at their site. Within a local server farm environment, service differentiation can be accomplished through quick response time to HTTP requests and avoidance of timeouts, known to Web users as "no response, server down or not responding." To claim these service attributes, carriers must utilize **traffic direction tools** that:

- Prevent the caching functionality of web browsers from identifying a multi-server farm as one entity
- Seamlessly load balance among multiple servers
- Provide for transparent failover if one server fails.

Figure 9 portrays a schematic of how to deploy this type of performance-enhancing tool, and Figure 10 illustrates a variation of this for larger networks that have server farms distributed at multiple locations.

8.0 Service-Level Agreements (SLA's)

Enterprise customers with VPDN or server hosting applications are more likely to outsource if there are agreed-upon levels of service. SLAs for end-to-end service across the public Internet are not possible using today's ISP peering model, but they can be offered for single-vendor IP transport or public Internet server hosting. These agreements generally require that a customer subscribe to a particular class of service (COS) such as premium or. standard, and then sign an SLA associated with that COS. While end-user performance levels cannot be ensured, packet throughput levels within a private-IP-network or server-farm-provisioned service definition can be measured and offered as part of an SLA.

Carriers can implement premium COS in an IP network by using **IP precedence** for traffic prioritization and **weighted random early discard** (WRED) for congestion control. In combination, these software technologies provide differentiated performance characteristics for different traffic classes/service levels.

SLAs can be provided on a customer or service-specific basis. Regardless of the service definition, a network **flow analysis and reporting** tool **is needed** to measure and report packet flow attributes. These detailed network measurements allow carriers to assess, and prove if need be, compliance with a particular SLA. Additionally, they also allow service providers to introduce pricing based on application, usage, time-of-day, or traffic priority. Performance can be maximized by using a flow analyzer that utilizes **cut-through switching** for each flow. This technology eliminates the need to analyze each packet by applying the attributes of the first packet to remaining packets in each flow, thus significantly enhancing throughput.

9.0 Security Services

For enterprises to outsource access to their networks and servers containing sensitive information, service providers must prevent unauthorized access, provide secure transport of data, and protect network elements from unwanted external influence. As in the case of virtual private dial services, security solutions can be offered separately or as part of a managed solution. In either case, carriers can draw upon several technologies to ensure the security of customers' networks, including:

1. Authentication—Verification of login ID/password
2. Authorization—Deciding users' access privileges
3. Accounting/Auditing—Reporting users' activities while on the network

Figure 7: MEDIUM / SMALL BUSINESS - WHY NO PLANS ?

1. Do not see what business advantage I would obtain
2. Do not understand Internet technologies
3. Do not have technical expertise to evaluate/buy equipment
4. Too costly
5. Security concerns

Figure 8: MARKET OPPORTUNITY FOR VALUE-ADDED SERVICES

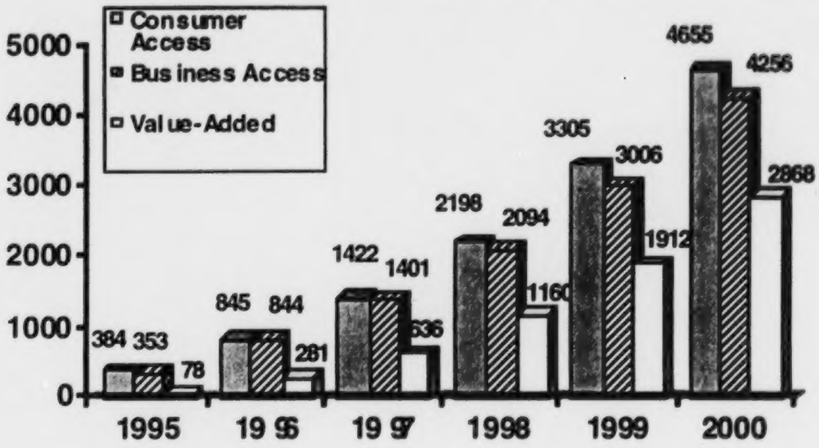
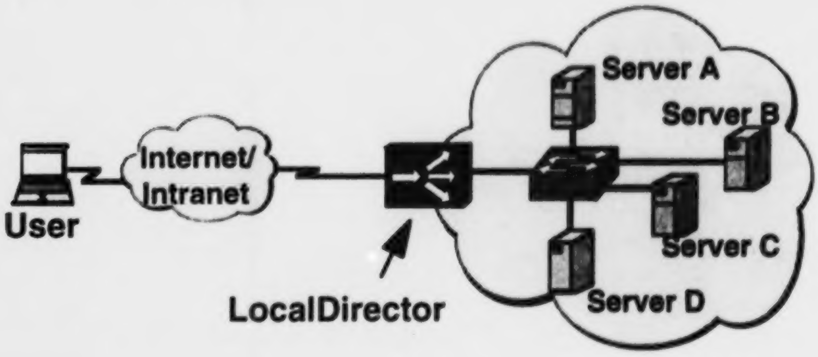


Figure 9: DISTRIBUTING TRAFFIC ACROSS MULTIPLE WEB SERVERS



User
Internet/
Intranet
LocalDirector
Server A
Server B
Server C
Server D

4. Packet Filtering—According to IP addresses or applications e.g., email (SMTP) or Web (HTTP)
5. Restricted routing—Restriction of users' access to specific networks or transport paths
6. Encryption—Scrambling of transported data
7. Remote monitoring and management—External alerting in the event of a breach or failure

Authentication, authorization, accounting are used to validate user access to corporate VPDNs and ensure that correct user privileges are granted. For an additional layer of authentication control, smart cards (cards that generate dynamic passwords) can be used, making use of industry standard protocols such as TACACS and RADIUS.

Packet filtering and server proxies allow the service provider to provide very robust secure solutions, whether for VPDN remote access or server hosting applications. Most packet filtering takes place on a router, sometimes referred to as a **choke router,** used between the server proxy and the internal corporate network. They can also be used to enforce security policy and restrict routing of packets to pre-determined networks, subnets, servers or hosts.

Firewalls are server proxies that mirror outbound server applications contained on internal servers and allow only outbound connections to be made. Firewalls can be simply resold as CPE (and managed by the customer), or can be part of a fully managed solution (managed by the service provider). Competitive differentiation occurs when security is enhanced, when redundancy is implemented, when networking is made easier, or when performance is maximized without compromising integrity. Examples include using **non-UNIX** based software code (UNIX-based proxy server code is widely available), **hot standby** options, **network address translation** (NAT) to allow IP address interworking between internal and external networks, and **cut-through proxies** that increase performance by not using application layer packet examination.

Given that user data (whether content or authenticating data) can potentially be intercepted, two **encryption** methodologies have been developed. First, **public key** technology makes use of two "keys," one public and one private, for encrypting and decrypting data between communicating parties. Second, **symmetric key** technology requires that both parties use the same key. The RSA algorithm is an example of public key technology, and the DES algorithm, used in Kerberos systems, is a symmetric key technology.

Several methods currently exist to take advantage of encryption within a service offering. **Application layer** encryption is used in firewall and server software. For firewall security solutions sold as CPE, the encryption process (key exchange) is managed by the customer. If part of a fully managed security service offering, management of encryption within the firewall should be included as part of the service. Encryption can also be implemented on network routers, most likely between the choke router and the POP router. Such **network layer** encryption methods are preferable as it is more difficult to centrally manage premises-based firewalls and the security of router operating systems.

As part of the security service offering, a **site monitoring** feature enables telco personnel to remotely monitor the system when suspicious events occur.

10.0 Managed Access Services

Telecommuting employees, mobile workers, and remote branch offices must have highly available access to corporate networks. While these customers could dial long-distance or freephone numbers for access, a higher quality and more cost-effective approach is to dial into the point of presence (POP) of partner ISPs, and use the public Internet for transport to the corporate network. Through the use of **tunneling protocols,** remote workers can securely access their corporate network through the public Internet and pay only local access charges to participating ISPs', if applicable. This service (or feature if part of a larger definition) is known as **virtual private dial access**. (See Figure 11.)

Enterprises wishing to outsource remote dial capabilities should be offered a stand alone virtual dial service; however, most service definitions should incorporate virtual private dial access as a *feature* within larger and more bundled service offerings. (For an example, see the hypothetical service definition for VPDN remote access following the next heading, **highly secure networks**.) Using virtual private dial access, carriers who provide virtual private dial network (VPDN) services can differentiate themselves from many ISPs who can only offer remote connectivity through their limited points of presence. This, in combination with the large network footprints of most carriers, satisfies customers' needs for widely available access and provides a competitive advantage for carriers who provide IP services.

Security services customers are prime targets for penetration with an eventual goal of a fully outsourced solution, including IP multimedia applications, at the end of the migration path. As such, many service offerings include security features as part of a larger service definition, especially as servers are outsourced.

11.0 Extranet Service Definition

Customers who have an Intranet within their organization often find their next step is to extend their network to their key external business partners and customers. Called an Extranet, this service provides a secure way for those outside a company to access network resources inside the company. Typical examples include parts suppliers, regular shipping companies, distributors, and major customers. The remote users' access might be via dedicated access

Figure 10: HANDLING GEOGRAPHICALLY DISPERSED WEB SERVERS

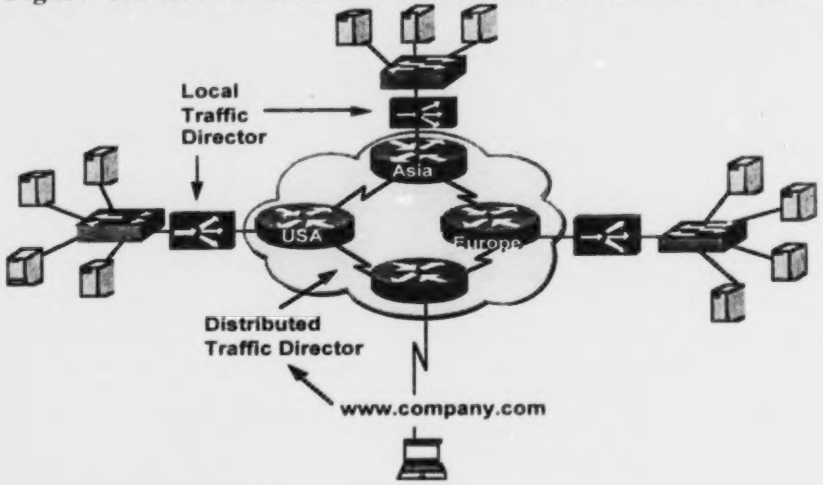

Local
Traffic
Director
Asia
USA
Europe
Distributed
Traffic Director
www.company.com

Figure 11 : VIRTUAL PRIVATE DIAL ACCESS USING PUBLIC NETWORK TUNNELS

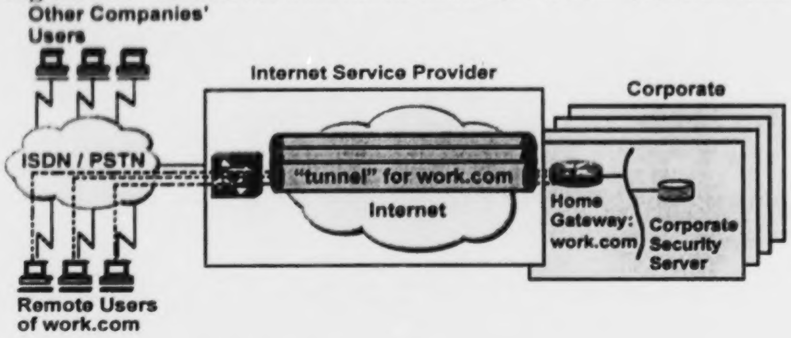
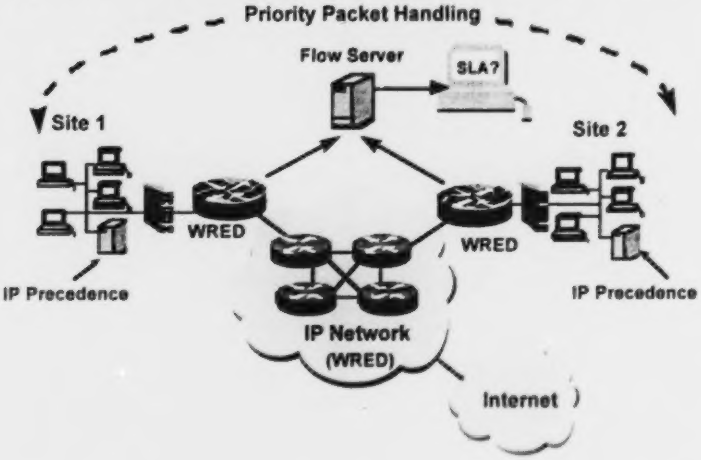

Other Companies'
Users
Internet Service Provider
Corporate
ISDN / PSTN
"tunnel" for work.com
Internet
Home
Gateway:
work.com
Corporate
Security
Server
Remote Users
of work.com

Figure12 : PROVISIONING EXTRANET CLASSES OF SERVICE


Priority Packet Handling
Flow Server
SLA?
Site 1
Site 2
WRED
WRED
IP Precedence
IP Precedence
IP Network
(WRED)
Internet

lines, or via dialup PSTN connections. Encryption can be offered, especially for dialup access. Extranets (Figure 12) are becoming popular since they improve distribution channels, provide a new level of customer care, and streamline operations while reducing costs.

Extranet services provide a combination of access circuits, remote dial connectivity, transport services, managed routers, Internet access, security/firewall services, and performance reports. Additionally, they can include server hosting (including transaction processing), systems integration and content development. Therefore, the extranet service provides carriers with the best vehicle for IP services account control.

Business customers can realize a substantial competitive advantage by aligning with a strategic telecom partner with the expertise and resources to adequately perform this role. Carriers who are properly positioned to address this reality are those that will achieve revenue growth today and account control tomorrow in a highly competitive, dynamic marketplace.

12.0 Putting It All Together

We have described a variety of value-added services as if they were provided one at a time. Of course the best situation is for the telco to provide an integrated package of services, tailored to each market segment. This provides the strongest competitive position, as many new entrants will be offering a single service, or only a few. An integrated, turnkey solution with both public Internet applications such as server hosting and security, and applications such as VPDN, intranet, or extranets, provides an excellent method for carriers to secure or maintain account control.

While this package approach is optimal for a telco, there are situations where it is not possible, and a more incremental approach to sales must be taken:

- Customers who have existing data comm equipment, are reluctant to accelerate its replacement, and need to maximize its utilization
- Customers who have contractual commitments to other service providers
- Customers not yet understanding the benefits of working with a single service provider

The individual value-added services outlined above, including remote access, security services, and high performance hosting, can be incrementally offered in addition to backbone WAN transport to provide a customer migration path toward an end-to-end solution.

13.0 Conclusions

With all of the good reasons presented, why are some telcos holding back? Even among the Regional Bell companies and GTE in the U.S., as an example, only a few are now offering Web hosting services. The reasons seem to be that carriers venturing into the world of value-added services require new skills, new personnel and a new vision of competitive marketing. This is a major change for most, and many are just beginning to develop the facilities, staff, and launch vehicles to succeed. In the meantime, many traditional telcos are losing ground to aggressive ISPs, and sometimes to global carriers, who possess the technical and marketing expertise to bring robust services to market quickly. In many places on the Pacific Rim and around the world, ISPs are well ahead of the incumbent local telco in offering retail Internet access and services to both businesses and consumers. The market for value-added services is the next likely target..

Many carriers believe that retail Internet services pose only a minor threat to their base of telecommunications services, especially if they are profiting by providing wholesale Internet transport or access to ISPs. But carriers cannot ignore the strategies of new ISP's to penetrate and control business accounts. These efforts have been made more viable by continuing deregulation of U.S. and world markets. ISP business plans include strategies to break into carriers' account bases with Internet access and value-added services with the intention of replacing traditional communications applications such as voice, fax, and conferencing with IP-based solutions. As the gradual consolidation of ISPs continues, combined entities will gain significant market share, and some will eventually construct their own access and transport facilities. Carriers that ignore the opportunity to either compete with, or acquire, ISP competitors will soon find themselves losing account control, revenue and market share. The time to act is now.

Remember, too, the important role that telecommunications plays in advancing the economic and social development of a country. On the Pacific Rim, and around the world, the Internet is rapidly becoming the preferred technology and service for conducting business of all types. Who better than the local telco, with intimate knowledge of local markets, regulatory issues, and customer needs, to be at the center of this new initiative?

Communications carriers today have a great opportunity - if they can move beyond just seeing themselves as providers of transport services. They are uniquely situated to provide the expertise, storage facilities, and transport mechanisms to enable the convergence described above. To generate new revenue and protect market share in the future, however, service providers must move toward offering **end-to-end, turnkey solutions** that move enterprise customers in the direction of external and internal integration within the Internet's technical paradigm.

Business Opportunities in Digital Broadcasting

Fred Fourcher
CEO
Miralite Communications, USA

Abstract

Advances in digital technology have made Digital Broadcasting a viable business opportunity for Satellite operators, Telcos and Cable companies. New products and services based upon digital technology are being introduced as never before. What are the market barriers and what are the opportunities? Explore these questions as well as some of the innovative applications for digital broadcasting. Look a head at the possibilities for unique audio, data and video services.

Opportunities change as technology evolves. When technology moves rapidly there is an abundance of business opportunities available to those who perceive them first. Take the telephone as an example. The telephone has operated on fundamentally the same principal for over a century. Suddenly the transition from analog to digital has provided incredible new opportunities. I am sure many of your businesses in telecom are as a result of efficiencies provided by digital technologies. Similarly, what we know as Television has operated fundamentally the same for over half a century now. Theoretically, the original vacuum tube TVs would be able to receive the *X-files* without any problems. As the world evolves to digital technology, television as we know it will undergo a radical change. Three years ago DirecTV started broadcasting digital signals direct to the home. This had been tried before and failed. However, at approximately the same time that DirecTV first launched, digital compression technologies had evolved to the point that direct to home broadcasting became a viable business opportunity. Recently, I was flying out of LAX and saw a large banner on the DirecTV building that said, "*Thank you America. 3 Million Subscribers in 3 years.*" In the case of DirecTV, technology evolved and opportunity was perceived.

Moreover, opportunities abound throughout the entire spectrum of telecommunications. The blending of technologies and companies is promoting the development of new telecommunications products and services. This market synergy has generated revenues in the billions of dollars. A solid testimony to this evolution can be found in the stellar rise of companies like WorldCom and Turner Broadcasting.

Companies like these have perceived opportunities before the competition, leveraged technology, and then worked diligently for their success. Before I present some of Miralite's specific interests and perspectives as they relate to digital broadcasting, I wanted to emphasize that success doesn't happen by chance. Thomas Edison, perhaps one of the greatest inventors put it this way, *"Genius is one percent inspiration and ninety-nine percent perspiration."* Sure, it is always good to have some investment capital and strong business partners, but more than that today's telecommunications President or Investor must work hard to create or leverage innovation, just to stay competitive.

The title of this presentation is Business Opportunities in Digital Broadcasting. Let's discuss some fundamental changes in technology and opportunities that exist today.

In the analog world, broadcasting has been confined to transmission mediums based on radio frequencies, such as satellites, TV, Radio and Cable systems. Thanks to digital technologies you can combine media such as MPEG-2 Digital video with digital infrastructure such as ATM allowing broadcasting to break free of its former limitations.

At the same time broadcasters now include Telcos, Cable, and Satellite operators. The Telcos, Cable and Satellite operators each build upon their existing infrastructure and ability to innovate to develop their own flavor of products and services. So although the methods are different, the goal is the same. The market forces will always reward operators that provide desirable content in the most efficient manner. It is important to point out that the value created is a combination of effective innovation and marketing.

The success of direct-to-home broadcasters has been especially politicized, as there are only so many slots in each country. The licensing requirements alone require Broadcasters to match their services with the political and cultural values of their constituents.

Clearly, it is not just market forces that influence the mix of products and services.

Supposing that a combination of Telcos, Cable and Satellite companies get licensing approval and enter the direct to home market, lets make a basic comparison to gauge competitive advantage. In the case of direct to home broadcasting, Satellite operators appear to have a competitive advantage. They do not have to build a massive terrestrial infrastructure and have a cost-effective set-top box and dish. However, their annual satellite cost per digital video channel is about $300,000. This means you cannot run a satellite direct to home business with a large number of channels and a small number of subscribers. Case in point would be last year's failure of AlphaStar.

On the other hand, in order for Cable companies to go digital they have a substantial investment to add more channels. One must ask if this investment will pay off over the 50 or more channels currently delivered analog? Likewise, Telcos also have a substantial investment and must be prepared to examine their return on investment. Interestingly, I have read that when a cable company adds telephone to their service, a substantial number of people sign-up because they are tired of dealing with the poor service of the Phone Company. When phone companies start offering video will a substantial number of people sign-up because they are tired of the poor service from the Cable Company?

What are the opportunities? Digital broadcasting lowers the cost of transmission about 10 times lower than analog methods. Look at your network and whom it reaches. Consumers, Businesses, Schools or? What can you deliver that is of value? Data in the form of Internet, or Intranet, Video, Audio, Telephony, or?

Audio Services

CD quality music channels are part of most direct to home services and are one of my favorites. How about selling audio channels like the airlines do, that offer infomercials to consumers. In-store music sells for about $100.00 per month per store. One step further is to offer customized music channels for large retailers providing point of sale advertising. Audio in digital form can be stored and played at intervals for advertising or Music on Hold in stores or businesses. In the case of satellite, distribution of radio channels across a region for rebroadcast can be done more competitively than current single channel solutions.

Video Services

Let's discuss the opportunities beyond just re-broadcasting CNN and Movies. With digital video you can adjust the resolution and frame rates to increase compression. Applications that are price sensitive can be broadcast at half the cost of regular channels provided quality could be sacrificed. An example of this would be distance learning. Distance learning can provide excellent profitability for a broadcaster. It is the lowest cost content to produce. Students are willing to pay for access and tuition. Geographical distances are overcome between students and teachers when live video is combined with live Internet interactivity.

Digital video does not have to be broadcast live since it can be stored easily. There is a large oil company in the U.S. with convenience stores that will be implementing a system in 1998. Each store will have a small video server that stores about 10 minutes of video. The server plays the video back repeatedly until the updated video is transmitted either hours or days later (This must drive the store clerks nuts). Non- real time video can be delivered at much lower data rates and subsequently lower transmission costs. Another large retailer is able to transmit video to a central server in each of their stores and then play back video in each department. This video and audio will play back repetitively in some areas of the store and in other areas will be interactive with the customer. For example, a customer can scan the bar code on a videocassette and see a 2 minute video clip of the movie on the monitor in that department.

In-store advertising is another profitable service since it delivers the message at the point of sale. Broadcasting live is very low cost and does not require expensive equipment at the receive site. Satellite digital video channels cost between $7,500 to $30,000 per channel per month depending on receive antenna size. $7,500 per month might be a 3-meter antenna whereas the $30,000 per month could be a half-meter antenna. Your choice of antenna size is driven by the potential size of your network.
Distance Learning can be profitable and is a desired content. We have seen that Direct to Home broadcasters can generate additional sources of revenue and get political kudos by incorporating educational programming into their business module. There is a direct to home broadcaster in Asia that will offer Distance learning for 1/3 of their programming. People will pay a monthly fee to receive various distance learning packages, then pay tuition for the classes they want to participate in and receive credit.

Foreign classes for high tech graduate level courses can be taken using live Internet interactivity with the instructor.

In any city there are various sporting and news events on television channels that are transported locally or regionally by satellite or microwave. A digital broadcaster usually has an efficiency advantage over single channels transmitted on their own. Selling individual channels to other broadcasters can be very profitable and add content to your system.

Business Television is very popular in the United States. Most major corporations have business television networks. By providing hourly rates for corporate or educational users you can provide corporate training and information into small antennas to be used in branch offices or stores region wide.

Data Broadcasting

Everybody is talking about Push technology. An example of this is PointCast on the Internet. With PointCast you fill out a user profile and specify the information you want to receive, such as specific news or stock quotes. Pointcast will then broadcast to you the specific information you requested on a regular basis. This information will be stored on your computer in the cache and be available to you immediately when you point your browser to Pointcast. With broadband broadcast networks it adds a whole new dimension to Push. You now can send quality video and audio that would not be possible over standard Internet connections.

You read the newspaper because you have control over the content you view. You watch television because of the depth of the media. If a picture is worth a thousand words what is video worth?
If you could control television and see only what you want when you want it, what would that be worth? The technology to do this is emerging now. Loral's Cyberstar will be one of the first to enter the market with delivery of Internet and Push technology by satellite. To deliver data you need a card in a PC capable of receiving the signal. If you can afford to operate at 30 Megabits per second, such as a whole satellite transponder, there are low cost cards around $300.00 made by Adaptec and Hitachi. If you want to start small with specific information there are narrow band cards capable of operating at a couple megabits per second. These cards cost about $1,200 each. This is ideal for a corporate Intranet type service.

What's Next?

I read a statistic last month that nearly half of Colorado adults - 47 percent - said they used a computer to access the Internet in the last 30 days. In countries with much lower computer penetration how do you deliver digital Internet Push type content? Rockwell just released a new video encoder chip (Bt868 and Bt869) that will turn TV's into PC monitors. This new flicker free video encoder from Rockwell will enable true living room PC applications. When the set top box can receive, store and display video, audio and data either live or in an Internet format then we will be able to penetrate into many new markets. Imagine DirecTV with WebTV, tuned up with content and features like never before.

Two-way by satellite is just around the corner. There is a company in San Jose that has a low cost system designed for 300 KBPS outbound and up to 30 MBPS inbound. This system would work with standard direct to home systems. Ka band satellites will be launching soon that will be capable of many small spot beams. Like cellular systems that use the same frequencies from cell site to cell site, a Ka band satellite is not limited to just one footprint that covers a region. This will allow cost-effective delivery of Internet and Push technology on a two-way basis. Think of the possibilities.

Conclusion

I hope this discussion has been thought provoking and allowed you to perceive new opportunities in your area of telecommunications. I encourage you to think about some of the questions I posed throughout this presentation. Unlike Thomas Edison, you do not have to invent the equivalent of the light bulb in order to create a new product or service in digital broadcasting. Likewise, you do not have to pursue opportunities alone. Loral, Hughes, Lockheed and others are looking for regional partners for their direct broadcasting plans. There have been many successes so far for those that have partnered with DirecTV in Latin America. The DirecTV partner in Colombia told me that they are way ahead of projections since they initially projected 4,000 subscribers in the first year and now have 40,000 subscribers in five months.

Digital broadcasting is profitable and offers unparalleled opportunities, some of which we have not even thought of yet. As Francis Bacon wrote, "*Time is the great innovator.*" Will you be the next to perceive a great opportunity in digital broadcasting?

The Price to be Paid: Assessing the Opportunity for New Cellular Franchises in Asia-Pacific Markets

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1. Abstract

Bidding for cellular licences is always a balance between offering too little for a licence and being outbid by less risk adverse competitors, and paying too much and finding that the long-term returns for the project are unacceptably low. One way around this dilemma is to concentrate on the business case closely with a view to finding new ways of adding value that others have not considered properly. There may be clever marketing options that can be applied that competing consortia have not thought though as well. This could include the application of the right value-added services, the right distribution structure and the right blend of promotion and advertising. Fixed or semi-fixed wireless local loop may be an effective way of boosting bid value. Finally, the business case must be realistic - avoid the temptation of applying an artificially high share of additions or high calling rates which cannot be borne out by the best available assessment of the market place.

2. Introduction

With the intensification of competition in terrestrial mobile telephony in many countries across the Asian-Pacific region, both developing and developed, the opportunities for entry into these markets is increasing. The method of entry will differ with government tenders, private sales and public spectrum auctions being the most common types. But in each case those companies seeking to contest the acquisition of new cellular franchises or purchase stakeholdings in existing operators must be aware of the range of factors which affect the value of these opportunities and ultimately affect the purchase price.

In broad terms the most important elements which must be considered in making a realistic assessment of the true value of licences are:

- Size and Wealth of the Market
- Determinants of Market Share
- Patterns of Network Usage
- Costs to Setup, Operate and Maintain the Cellular Network
- Strategies to make your Bid Successful

The purpose of the paper is to provide a framework to allow the evaluation of market opportunities while new cellular licences are being offered by governments or regulators. Ultimately the right price is a value that should not be influenced by sentiment or jeopardised by lack of knowledge in key areas, but should reflect the investment's true worth.

3. Size and Wealth of the Market

The value of any cellular phone licence is driven fundamentally by the size of the market. The size of the market is related not only to the population of the region, but also the personal income of its inhabitants.

A reliable way to estimate the potential demand in a new market is using a model that relates the mobile phone service back to its *affordability* in each household income segment. The level of household disposable income in different income groups is matched with the basic cost of mobile phone ownership. Across most telecommunications markets, it has been observed that households are prepared to spend between three to four per cent of their mean household income on cellular telecommunications services. Hence it is possible to estimate the latent demand for cellular services over time.

In the early years of operation of cellular phone services in any country, it can be observed that the level of realised or actual demand is typically well below latent demand as predicted by the affordability model of economic wealth. Nonetheless, in time it is expected that actual demand will rise according to a logit or S-curve with low growth initially, high growth in intermediate years and lower growth in later years, as penetration of cellular phones into households reaches high levels. The size of the market predicted by the affordability model is that which fits the existing level of demand and the long term saturation level predicted by the calculation of latent demand to a S-curve. Like a range of consumer products, the product life cycle of mobile telephones is likely to exhibit the classical shape of an S-curve.

While officially published statistics and market studies are essential as a starting point of household income levels, it is also necessary to estimate the size of the black market in order to derive maximum value from the opportunity.

By its nature, information about the size of the black economy is difficult to obtain, but can represent 20% or more of official income. Even market research studies may not capture the value of the black economy as people responding to surveys about their total income may be reluctant to disclose money which has not been declared to the government. The question which is relevant is not simply the size of the black economy, but whether its size is spread consistently across all income bands. As a rule of thumb, the size of the black economy is likely to be greatest in the highest income bands where money can be laundered by various means or in low income groups which rely on the cash economy. The important middle income levels whose income may be marginal in terms of being able to afford mobile phones is likely to be boosted by the black economy less than those who can already afford them or those who fall well below the threshold of affordability.

4. Estimating a realistic Market Share for your Business Case

An understanding of the consortium's market share is also a critical part of the business plan's intrinsic profitability. The group's share of net additions must be assessed realistically through knowledge of the relative strength of the competition together with a plan for marketing and operation of the carrier's own network.

One way is to look simplistically at the share of net additions. In a 4 player market, is it realistic to assume that 25% of net additions can be obtained in the first full year of operation? More systematically, it is relevant to analyse gross additions in its constituent parts. This involves looking at the three sources of gross additions: churners onto system, churners off system and, most important in usual existing market situations, churners from other operators.

Often there is strong dissatisfaction of existing cellular operators among their existing cellular customers. A competent new operator can expect to attract a strong churn from this group. This will be strengthened by a typical entry strategy which is to enter the market a price discount of between 10-20% and with a strong commitment to customer service. Such a commitment needs to be more than just posturing, but realised through an adequate staff ratio for Customer Service Representatives. Generally a ratio will be in the range of 1,200 to 1,500 subscribers per CSR for organisations who place a high priority on customer service.

One key question to keep in mind is what level of population coverage will be available at launch with many operators being in the range 50% to 70% of the existing operator's demand on the day of launch. Often a coverage which is less may have a detrimental effect on the long term image of the new entrant. Of course the downside of a higher starting coverage is that the launch will be delayed and revenues lost in the intervening months.

Finally, it is important in the calculation of market share to avoid the temptation of boosting the bottom-line IRR by apportioning an artificially high share of additions to the consortium. Give yourself a higher market share than the encumbent only where there is a genuine reason for doing so.

5. Predicting how your Customers will Use the Network

Together with market size and market share, the level of utilisation of the network is a critical driver of the value of cellular businesses. If the total number of billable minutes is reduced by 50% for each year of the forecasting horizon, say from 200 to 100 billable minutes per month per subscriber, this could be expected to reduce the NPV of total revenue by around 30% and create a massive reduction in project IRR. While billable minutes are clearly a critical line item, information about them is often difficult to obtain with regulators and government being the most reliable sources.

Secondly, an assumption is necessary in the model about the change to the existing level of usage over the forecasting horizon. In most markets a pattern of decay in billable minutes has been experienced over time because new customers tend to be marginal in nature. They are lower users who were not attracted initially because of their lesser needs or lesser capacity to pay. This may be offset by a change in usage patterns of some customers who begin to consider the telephone as the instrument of first choice or where the difference between tariffs between the fixed and mobile networks begins to diminish.

6. Costs to Setup, Operate and Maintain the Cellular Network

A good understanding of costs is also important. Costs are many and varied in nature, but broadly speaking can be classed into capital expenditure (capex) and operating expenditure (opex).

Equipment providers are a valuable source of information but often their prices do not reflect their final offers. Some vendors will promote one type of technology, while another choice of technology may be more suitable. Apart from the capital expenditure of MSC, BTS, billing systems and the like, a good understanding of operating costs as they apply in each market is essential.

Both capex and opex should "flex" to changes in demand and other variables as fully as possible. While it is relatively simple to flex opex, capex is more difficult. The most precise method to estimate capex for a licence bid proposal is to carry out a separate RF engineering study. This would use subscriber numbers provided to the engineering team from the affordability model together with coverage objectives detailing the extent of population to be served in the licence area.

While this is a method which offers precision, it is slow, laborious and developed separately to the financial model. Hence, if the bid team decides that a more optimistic set of subscriber numbers is possible, or if coverage objectives need to be changed, it is not possible to see the effect of this on capex (and hence bottom-line profitability) without a delay of perhaps days while fresh engineering studies are carried out. It is therefore suggested that financial models should not accept external engineering studies passively, but internal modelling needs to be used which, although not as accurate as a full engineering study, will provide immediate feedback on the impact of any new subscriber or other numbers.

Although capex extends beyond the cost of network infrastructure, it is the most important initially, particularly since the bulk of network rollout falls before launch and in years 1 and 2 post-launch. A useful rule-of thumb in assessing the network capex costs is cumulative capex per subscriber is generally in the range US$400 to US$600 per cumulative subscriber after 10 years of operation.

Of course one of the most important areas of capex is the licence fee itself. The timing of the licence fee payment and the possible payment of interest on the licence fee must be considered. The magnitude of the licence fee should be considered at the end of the modelling process after core assumptions have been bedded down firmly.

The most important opex components are ongoing maintenance of network installations, spares and replacement parts, rental of transmission backhaul, site rental costs, staff, promotion and advertising, bad debt and general overheads that that cannot be readily allocated to specific opex categories.

7. Strategies to make your Bid Successful

The bid will be successful if your bid is the highest and it is not disqualified by the local regulator or a challenge by one of your competitors. There are also a number of *"facilitators"* which will improve the chances of success in a practical sense.

Adding Value to the Bid Submission

Making your bid the highest is not a case of bidding irrationally with the blind intent of success. The correct way to tackle the issue is to search for ways which can add legitimate value to the business case which will provide the basis for your bid to be increased. Finding those extra dollars might turn your unsuccessful bid into a winning bid.

One area where value can be added is value-added services. In the early years it would be expected as a rule of thumb in a market of moderate wealth that value-added services will constitute about 5% of total revenue. Rather than relying on a simple percentage, a more systematic and better way to calculate the value of value-added services is to separately itemise each service which is considered feasible in your market. Some VAS such as data will be quite modest in early years but will pick up significantly in later years.

Another important source of additional revenue is fixed or semi-fixed wireless local loop services. For specific spectrum in the 800 MHz, 900 MHz, 1800 MHz or 1900 MHz many licences will allow fixed wireless local loop, and even more frequently semi-fixed services. By fixed WLL, the idea is that customers will be given a handset which ties them to their home or other fixed location. By contrast the concept of semi-fixed service is that people will be free to move around within their *home-zone* at a lower tariff than for the normal cellular service. It would be customary to define a home-zone as narrowly as possible preferably down to a sector of a BTS. Where calls are made beyond the home-zone, the call charge would typically be more than for standard cellular services. Whether, fixed or semi-fixed, both services are significant enhancers of licence worth.

Beware the winner's curse. Telecom bidding is littered with cases where the price bid did not match the true worth. Be prepared to lose. Bidding is a number's game where there is luck. With realistic bidding success may only occur with one in every 5 bids. Therefore, there is merit in bidding in many bids where you can - avoid bidding only if your business case doesn't stack up. Conversely, beware of the risks - these could be in terms of a deteriorating level of usage or unexpected price pressures.

Partnership Issues

In a foreign market where the new entrant may not have strong internal knowledge, the importance of the right partner should not be underestimated. In many circumstances the terms of bidding will mandate that local partners are included in the bidding consortium often with a majority voting rights of 51%.

Apart from the legal requirements, the partner can add skills which will facilitate the whole bidding process. This will include contacts with industry and government, local knowledge, local language skills, and the particular expertise related to the partner's normal line of business.

Timing is an important issue in hooking up with a partner. This will allow the full strengths of the partner to be assimilated into the consortium and will avoid pressure at a later time as the tender deadline draws closer.

A stable consortium, preferably with signed agreements between the parties at an early date, is critical. A consortium which dissolves as a result of the withdrawal of a partner can set the bidding process back many man-months.

Other Inputs into the Modelling Process

Of course there is a range of inputs which are required for the modelling process. There are numerous factors which may be important in a specific bidding situation only, while other factors are likely to be important in all situations.

All cellular investments which are based in a geographic region contain a *country risk* which could manifest itself unexpectedly in the medium or long term. The country may be subjected to unforseen events including political upheaval, economic dislocation such as what occurred recently in several Asian economies such as Thailand and Indonesia, or currency devaluation against the US dollar which makes cellular infrastructure more expensive domestically. A price war may break out among cellular competitors or inflation could reoccur. The local environment must be studied carefully to understand the nature of these risks.

Benchmarking is a valuable tool which can often be used in "sanity-checking" or "estimation" mode. A set of benchmarks taken from comparable situations in other countries or other cellular networks can serve as a check against local information. Are local estimates within the range that would generally be expected elsewhere? If not, what local factors could explain the difference? Where local information is not available, benchmarking can also be used to derive an informed guess about the likely value of key variables. Ideally, the use of benchmarking as the primary information source should be used on a temporary basis until specific local information can be obtained from market research or other sources.

One twist to the process is spectrum auctions. This will require additional work from the point of view of the bidding party because the rules of the auction process must be clearly understood. A strong understanding together with a software bidding tool which can analyse the results quickly is important. One form of spectrum auctions which has gained popularity are *simultaneous ascending multiple auctions*. These have been, or are being, conducted in the USA, Mexico and Australia. In the recently completed A to F block PCS auctions at 1900 MHz in the USA, the Federal Communications Commission (FCC) allocated 120 MHz of PCS spectrum in only 2½ years. Using administrative decisions and lotteries, the FCC took 10 years to allocate 50 MHz of cellular spectrum.

Towards Internet Self-Regulation: A Survey of Ethical Models

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Geno Baruffi

1. BACKGROUND

As the Internet continues to cross multinational boundaries and permeate the daily lives of individuals and corporations it becomes doubtful whether traditional regulation is feasible within this new realm of telecommunications.

Conventional issues in telecommunication regulations deal mainly with the means by which telecommunications are carried out, i.e., the "forms" of telecommunications.[1] This is evident also in the promulgation of most telecommunications regulations.[2] With the advent of the Internet, however, the regulation of the "contents" of telecommunications, i.e., the materials being conveyed by means of telecommunications, becomes an important issue.[3] This is due mainly to the relatively ease in both the usage of and service providing over the Internet (It is almost cliche to note, e.g., that almost anybody can post his or her Homepage on the Web).

As in any other human endeavor, the usage of or service providing over the Internet can be both beneficial and deleterious to society. If properly used, the Internet has proved invaluable in, *inter alia*, humanitarian assistance[4], education[5] ("The Pathfinder Web page . . . received 556 million hits during the first 30 days of the mission . . . 'The biggest Internet event ever,'"[6]), commerce[7] (" Credit Suisse Group . . . allows retail customers to make payments and buy and sell securities over the Internet."[8]), and medicine[9] ("A new Internet site aimed at helping researchers learn more about genetic links to cancer was unveiled"[10]).

Historically, the Internet has thrived on lack of controls (by multinational companies, technical standards, government, and other external forces). Any attempt to regulate the Internet may prove to be disastrous for its survival. Yet it is important to regulate Internet to prevent its misuse by hackers, intellectual property thieves, child-pornography peddlers, etc. Appendix I contains a collage of news items excerpted from Reuter's News Service which vividly shows some typical examples of Internet abuses and presents some of the events which may invoke ethical concern in the usage of and service-provision over the Internet.

In response to the perceived "anarchy" in the Internet, some governments have attempted to regulate the content of the Internet. For example, according to Poon[11], the Singaporean government agency responsible for Internet content regulation would institute strict censorship laws for Internet access as of 16 September 1996, calling the regulation "anti-pollution measure in cyberspace." Similarly, the Chinese regulatory law of 1 February 1996 is one of the most restrictive set of Internet regulations that appear in Asia.[12] Even among Western countries the regulatory trend exists. Reuters reported German authorities to have been among the toughest in the world in trying to curb misuse of the Internet and have recently passed legislation setting the framework for government regulation of it.[13] In the United Kingdom, the government plans to review the regulations concerning online lotteries following private plans to launch a online lottery in pubs and shopping malls.[14] In the United States, in light of the U.S. Supreme Court's decision invalidating regulation of "indecent" and "patently offensive" speech on the Internet,[15] President Bill Clinton backed private-sector efforts to protect children from Internet smut, without calling for new laws or extensive government intervention in cyberspace.[16] He endorsed the recommendations that companies make available software to filter out inappropriate material, that government should step up enforcement on the Internet of existing anti-obscenity laws, and that parents should get more involved in their children's Internet activities.[17]

While the proposed American approach may seem to come close to attaining a delicate balance between government regulation and freedom of the Internet, the authors believe that the eventual solution to a viable Internet environment lies in self-regulation. As Donald Lamberton pointed out during PTC '97, "Under conditions of social, economic and technological stability, behavior patterns of all parties may be so settled that an element of self-regulation can develop."[18] In this paper, the authors propose an initial framework for self-regulation on the Internet - one that includes the moral and ethical consideration of Internet service provision and usage.

2. METHODOLOGY

The purpose of this paper is to present a set of ethical/moral principles which may be utilized as ethical/moral rules of thumbs in the course of Internet usage and service-provision. In order to find out if Internet users and service-providers from a wide variety of backgrounds would reach any consensus in their preferences of ethical/moral principles, these principles were developed into a survey that consists of two parts. The survey is located on a website (http://vic20.mso.hawaii.edu/entryform.cfm) which can be accessed internationally. As shown in Fig. 1, The first part of the survey is made up of six demographic questions which prompt for the surveyee's primary Internet usage, usage frequency, experience with the Internet, gender, and continent. Fig. 2 shows the eleven ethical/moral principles which were adapted from the works of Carroll,[19] Das,[20] and Steiner and Steiner,[21] the descriptions (without names of principles) of which make up the second part of the survey. While Carroll and Das focused on the ethical/moral preferences of business managers and students, the present survey is targeted exclusively toward Internet users and service-providers.

3. INSTRUMENT

The purpose of our survey was to see if those that use the Internet could come up with a consensus on an ethical way of regulating the Internet. We adapted Dr. Archie B. Carroll's survey to suit our needs. The questions consisted of six demographic questions (see figure 1) and 11 ethical ranking questions (see figure 2).

1. How do you use the internet
2. How often do you use the internet
3. How long have you used the internet
4. Gender
5. Age
6. Country of origin

Figure 1. Six demographic questions

Ethical Principles	Name of Principle
1. You should not adopt principles of action unless they can,without inconsistency, be adopted by everyone else.	Categorical Imperative
2. Individuals should act to further their self-interests so long as they do not violate the law.	Conventionalist Ethic
3. If it feels good, do it.	Golden Rule
4. Do unto others as you would have them do unto you.	Hedonistic Rule
5. If you are comfortable with an action or decision after asking yourself whether you would mind if all your associates, friends, and family were aware of it, then you should act or decide.	Disclosure Rule
6. You do what your "gut feeling" tells you to do.	Intuition Ethic
7. If the end justifies the means, then you should act.	Means-Ends Ethic
8. You should take whatever advantage you are strong enough and powerful enough to take without respect for ordinary social conventions and laws.	Might Equals Right ethic
9. This is an age of large-scale organizations - be loyal to the organization.	Organization ethic
10. You should do only that which can be explained before a committee of your professional peers.	Professional Ethic
11. You should follow the principle of "the greatest good for the greatest number"	Utilitarian Principle

Figure 2: Ethics ranking questions

4. HYPOTHESES

Based on the results of Das and Carrolls who did similar surveys on middle level managers and business students, the authors proposed the following two hypotheses, which roughly correspond to the two groups above, respectively:

1. North Americans in the age group 30 – 49 who use the Internet at least once or twice per week will most likely subscribe to the Golden Rule principle.

2. Those under 30, regardless of location who use the Internet at least once or twice per week will most likely subscribe to the Disclosure rule.

5. RESULTS

A total of 172 people responded to our request some returns came via email but most were submitted via our website. The demographic information of the respondents is summarized below.

10-20	2
20-29	50
30-39	51
40-49	42
50-59	26
60+	5

Table 1: Breakdown of Age of Respondents

Male	120
Female	52

Table 2: Breakdown of gender

Almost Everyday	150
Once or twice per Week	20

Once or twice per month	1
Once or twice per year	1

Table 3: Internet usage frequency

When asked how they use the Internet, 47% of the respondents reported that they used the Internet primarily for work, the other results are summarized in table 4 and figure 3 .

Education	45
Research	37
Teaching	9
Work	81

Table 4: How internet is used.

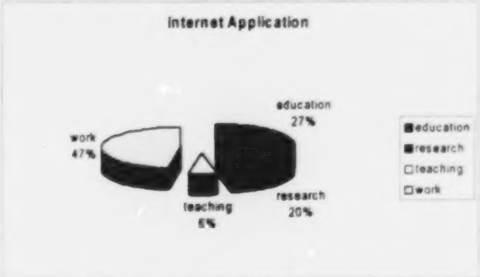

Figure 3: Percentage of respondents- how Internet is used.

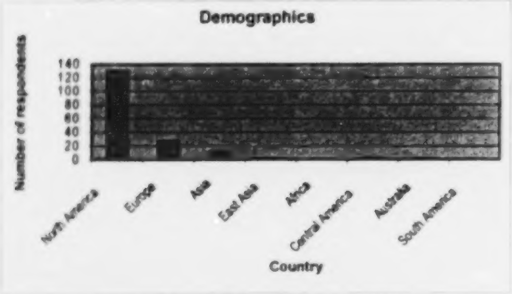

Figure 4: Breakdown of respondent origin.

Ethic Ranking	1	2	3	4	5	6	7	8	9	10	11
1. You should not adopt principles of action unless they can,without inconsistency, be adopted by everyone else.	40	46	20	77	42	19	14	20	24	24	33
2. Individuals should act to further their self-interests so long as they do not violate the law.	13	12	10	24	39	17	9	0	4	15	23
3. If it feels good, do it.	16	16	12	17	33	30	7	4	9	30	25
4. Do unto others as you would have them do unto you.	26	14	6	11	21	24	11	2	16	16	16
5. If you are comfortable with an action or decision after asking yourself whether you would mind if all your associates, friends, and family were aware of it, then you should act or decide	18	14	14	10	11	23	19	5	23	26	21
6. You do what your "gut feeling" tells you to do.	15	16	11	7	13	21	12	6	18	9	15
7. If the end justifies the means, then you should act.	17	9	13	9	7	10	14	7	15	9	9
8. You should take whatever advantage you are strong enough and powerful enough to take without respect for ordinary social conventions and laws.	12	19	19	3	5	11	18	9	16	13	9
9. This is an age of large-scale organizations - be loyal to the organization.	2	11	24	0	1	11	27	13	25	15	5
10. You should do only that which can be explained before a committee of your professional peers.	6	8	21	9	4	9	26	28	14	9	9
11. You should follow the principle of "the greatest good for	9	9	24	11	1	2	17	85	13	14	9

the greatest number"											

Table 5: Ranking of Ethical principles

6. DISCUSSION

In order to find out the surveyeess' preference of ethical/moral principles, the number of responses to each principle the author proposed was multiplied by their respective ranks and the results summed. The rankings, in descending order of preference, are presented in Table 6, together with those of Carroll and Das. The rule with the lowest sum would be the most preferred while the one with the highest sum would be least preferred. Our preliminary results shows that the overall most favored principle was the Means-Ends ethic. In other words a significant portion of the respondents indicated that they would follow an ends-justifies-the-means paradigm to when they are faced with moral/ethical dilemmas in the course of their Internet usage or service providing. The second most popular selection was the Might-equals right ethic, or 'he who has the gold makes the rules'. These preferences are in stark contrast to the results of Carroll and Das, who found the Golden Rule and the Disclosure Ethics to be most preferred among managers and business students. Nevertheless, the third most preferred rule of thumb is the Intuition Ethic, which was also the third choice of the Managers in Carroll's studies. The two least preferred principles are the Utilitarian Principle and Categorical Imperative, which were favored moderately favored in Carroll's and Das' studies. As Mr. Hans Zimmermann, United Nations Senior Humanitarian Affairs Officer, and an expert in emergency telecommunications, pointed out, the surveyees may be confused as to the exact meanings of the "greatest good" in Utilitarian Principle and "principles of actions" in Categorical Imperative, which may explain the low preference of these two principles.

It is important to note the preliminary nature of the present data set. Over the next three months the authors are expecting more responses to the survey, and the final set of data may indicate a different preferential scale for the eleven principles. Also, the authors do not feel that the present population size, n, of 154 is sufficiently large enough to test the two aforementioned hypotheses.

Carroll's Managers (n=88)	Carroll's Students (n=34)	Das' Students (n=265)	Present Study (n=174)	Present Study sum
3	3	3	7	683
5	5	5	8	781
6	11	11	6	848
1	10		10	890
10, 11	6	9	2	916
	1	6	9	938
		10	4	962
		1	5	1192
			3	1234
			11	1337
			1	1901

Table 6: Sum of Ranks

7. CONCLUSION AND FUTURE WORKS

As responses are trickling in everyday, the authors expect a final n of 300-400. The full analysis of the survey will be performed in the final draft of the present paper. It will include, among other items, an expanded and updated version of Table F, which will also include the preferences of the demographic categories of the two hypotheses, as well as those of different genders and geographical locations. Furthermore, the two hypotheses will be statistically tested for their validity.

The preliminary results, however, cast a shadow of doubt upon the feasibility of Internet self-regulation, since the top two preferences of principles may not be conducive to a healthy, thriving Internet community due to their rather brute nature. Future works may include the incorporation of these ethical/moral principles into a coherent set of decision-making procedures for users and service providers who face moral/ethical dilemma in the course of their Internet usage or service providing.

Fundamentally, the border-less nature of Internet makes it difficult for a single government to regulate. Also, it may not be possible for the government to keep pace with the technology while trying to police the Internet. Therefore, it may be a good idea for the industry to take upon itself, the regulation of Internet. Just as society has unwritten rules for people to act and behave, industry and the users can come out with a code of ethics that will govern the transactions on the Internet.

There are three distinct types of players on Internet:

a) Industry directly related to Internet (e.g., ISPs, Web page developers, Internet software developers, etc.);
b) Individuals and corporate that put up information on the Internet;
c) Internet users.

It is easy to regulate or develop ethical codes for the Industry, as its members are few, easily identifiable, and likely to be affiliate to their respective 'Associations'. However, other players can not be easily regulated (as they can be anywhere in the world).
The objective of this study is to find the preferences of such people, so that a proper ethical model can be evolved. The response is not quantitative enough to reach any conclusion. However, it may give some indication of the preference of the Internet users.
We propose to continue with our research (after any such suggestions or modifications proposed by all of you). After achieving substantial and geographically diverse responses, we would have a good idea of the preferences of the Internet users. The preferences of the Internet users would serve as a useful data while

Bibliography

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1. See, e.g., A. Ahmad, "VSAT Applications Advance as Asia Liberalizes", *Proceedings of 19th Annual Pacific Telecommunications Conference*, January 1997, 61-63; S. Clark, "Regulatory Solutions for Global Systems", *Proceedings of 19th Annual Pacific Telecommunications Conference*, January 1997, 82-86; H. Hudson, "Restructuring the Telecommunications Sector in Southeast Asia: Policies and Pitfalls", *Proceedings of 19th Annual Pacific Telecommunications Conference*, January 1997, 87-98; M. Reede and P. Water, "The Internet and telephony: The Impact of Under Control or technology on Tradiutional Telephony Regulation", *Proceedings of 19th Annual Pacific Telecommunications Conference*, January 1997, 625-634; J. Zarco, "Regulatory Structure and Its Impact on the Telecommunications Sector and Economics", *Proceedings of 19th Annual Pacific Telecommunications Conference*, January 1997, 705-713.

2. See, e.g., N. Boudette, "German States Balk At Fees For Internet PCs", *Reuters News Service*, 5 August 1997; "Internet operators Will Not Be Taxed For Two Years", *Financial Express* (India), excerpted by *Reuters News Service*, 2 August 1997.

3. See, e.g., A. Poon, "Internet Services in Asia: the Rapid Emergence of Competition and Regulation", *Proceedings of 19th Annual Pacific Telecommunications Conference*, January 1997, 636-638.

4. See, e.g., G. Borba, "The Internet and Disaster Response"; *Australian Journal of Emergency Telecommunications*, 10, 4, Summer 1995/96, 42; A. Boterell, "Network Technology in the Practice of Emergency Management", *Australian Journal of Emergency Telecommunications*, 10, 4, Summer 1995/96, 43; E. Kudashev, "Aeropace Methods Usage for ecological Monitoring and Natural Hazards Forecasting", *Addendum to the Abstracts for the Pan Pacific Hazards '96 Conference and trade Show*, 1996, 7; H. Zimmermann, "Crisis Response Communications: Telecommunications for the Service of Humanitarian Assistance", *Proceedings of the International Emergency Management Society Conference*, 1997, 329-334; [http://www.unog.ch/freq/freq1.htm]; [http://www.reliefweb.int].

5. See, e.g., J. Tiffin, "The Coming of the Virtual College", *Proceedings of 19th Annual Pacific Telecommunications Conference*, January 1997, 389-391; G. Baruffi, "Moving Towards the 6th Generation of Distance Education", *Proceedings of 19th Annual Pacific Telecommunications Conference*, January 1997, 493-502; A. Gloster, "Reinventing Education Through Information Technology", *Proceedings of 19th Annual Pacific Telecommunications Conference*, January 1997, 503-510.

6. "Mars Rover To Be Sent On A Hike Uphill", *Reuters News Service*, 8 August, 1997.

7. See, e.g., A. Gilbert and M. Singh, "Understanding the Impact of Network-Based Currencies", *Proceedings of 19th Annual Pacific Telecommunications Conference*, January 1997, 29-36; S. Singh, "The Use of Information and Communication Technologies In the Home: A Focus on Electronic Money", *Proceedings of 19th Annual Pacific Telecommunications Conference*, January 1997, 37-45.

8. *Tages Anzeiger* (Zurich), excerpted by *Reuters News Service*, 4 August, 1997.

9. See, e.g., J. Erbetta, "Telemedicine: Hopes, Reality and the Impact on Telecommunications", *Proceedings of 19th Annual Pacific Telecommunications Conference*, January 1997, 51-55; E. Parsons, "Interactive Communications Policies and the Health Experience", *Proceedings of 19th Annual Pacific Telecommunications Conference*, January 1997, 56.

10. "Cancer Genome Web Site To Aid Research", *Reuters News Service*, 1 August 1997.

11. A. Poon, "Internet Services in Asia: the Rapid Emergence of Competition and Regulation", *Proceedings of 19th Annual Pacific Telecommunications Conference*, January 1997, 636-638.

12. *Ibid.*

13. "German Couple On Trial For Internet Torture Offer", *Reuters News Service*, 7 August 1997.

14. "Online Pub Lottery Faces Review", *Financial Times* (London), excerpted by *Reuters News Service*, 30 August 1997.

15. Case No. 96-511, Supreme Court of the United States, 1997.

16. "Clinton Backs Private Internet Efforts To Protect Kids", *Reuters News Service*, 16 July 1997.

17. *Ibid.*

18. D. Lamberton, "Ethical Issues for Telecommunications: An Australian Perspective", *Pacific Telecommunications Review*, 18, 4, June 1997, 5-11, at 8.

19. A. Carroll, "Principles of Business Ethics: Their Role in Decision Making and an Initial Conensus", *Management Science*, 28, 8, 1990, 20-24.

20. T. Das, "Ethical Preferences among Business Students: A Comparative Study of Fourteen Ethical Principles", *Southern Management Association Proceedings*, 13-6, November 1985, 11-12.

21. G. Steiner and J. Steiner, *Business, Government and Society: A Managerial Perspective*, Random House, New York, 1980, 383-389.

22. "French Critics Slam Pope Over Grave Visit Plans", *Reuters News Service*, 8 August 1997.

23. "LA Judge Recalls Magazine With Nude Brad Pitt Pix", *Reuters News Service*, 8 August 1997.

24. "Scottish University Sacks Pro-Paedophilia Lecturer", *Reuters News Service*, 8 August 1997.

25. "German Couple On Trial For Internet Torture Offer", *Reuters News Service*, 7 August 1997.

26. "Venezuelan Beauty Queens Reach Out In Cyberspace", *Reuters News Service*, 6 August 1997.

27. *Biznes & Baltiya* (Estonia), excerpted by *Reuters News Service*, 6 August 1997.

28. *Washington Post*, excerpted by *Reuters News Service*, 5 August 1997.

29. "U.S. Lied To Explain Away "Ufo Sightings" - CIA", *Reuters News Service*, 4 August 1997.

30. "Feature - South Africa's Secret Society Comes Out On The Web", *Reuters News Service*, 1 August 1997.

31. "Net Firm Faces Fraud Inquiry", *The Guardian*, excerpted by *Reuters News Service*, 30 July 1997.

32. "Japan's Sokaiya A Mixture Of Thugs And Accountants", *Reuters News Service*, 30 July 1997.

33. "Spain Paedophile Network Has Ties Abroad - Police", *Reuters News Service*, 30 July 1997.

34. "Anti-Semitic "Franklin" Text Surfaces On Internet", *Reuters News Service*, 30 July 1997.

35. "At&T Sues California Internet Access Provider", *Reuters News Service*, 29 July 1997.

36. "Swiss Unveil Bank List Of Possible Holocaust Victims", *Reuters News Service*, 23 July 1997.

37. "Model Elle Macpherson Denies Having "Boy Toy"", *Reuters News Service*, 22 July 1997.

38. *The New York Times*, excerpted by *Reuters News Service*, 25 July 1997.

39. "East Timor War Of Words Spills Into Cyberspace", *Reuters News Service*, 17 July 1997.

40. *Delo* (Slovenia), excerpted by *Reuters News Service*, 28 July 1997

41. "Website Disabled By Anti-ETA Computer Users", *Reuters News Service*, 19 July 1997.

42. "Insurer Norwich Union Pays Out For Internet Libel", *Reuters News Service*, 17 July 1997.

43. "Spain Asks Cnn To Remove Website Link To ETA", *Reuters News Service*, 16 July 1997.

44. "Girl Kills Self After Boyfriend Row With Parents", *Reuters News Service*, 14 July 1997.

45. "Parents Foil Missouri Girl's Runaway Bid", *Reuters News Service*, 15 July 1997.

APPENDIX I

"[R]ebel bishop Jacques Gaillot, ousted by the Vatican from his diocese in 1995 . . . runs a "virtual diocese" on the Internet to spread his views."[22]

"[P]hotographs of movie star Brad Pitt in the nude . . . appeared on the Internet [without his permission]."[23]

"[A] controversial psychology lecturer who said there was nothing wrong with pedophilia if the child was intelligent and willing . . . [made] the comment in an electronic newsletter on the Internet."[24]

"A German couple went on trial in a Bavarian court on Thursday accused of offering over the Internet to acquire children for torture."[25]

"Venezuelan beauty queens . . . will appear in skimpy swimsuits on the Web"[26]

"Oleg S, arrested by the Estonian police on suspicion of being the internet blackmailer Viktor,"[27]

"WASHINGTON - A group of Internet users who are angry about the mass posting of advertisements on electronic bulletin boards have blocked or destroyed thousands of postings . . ."[28]

"Studies of Intelligence, a once-secret journal of intelligence-related material . . . The latest issue is at http://www.odci.gov/csi/studies/97unclas/ on the Internet."[29]

"South Africa's most powerful secret society has come out of the closet and onto the Internet."[30]

"Internet software group Display IT . . . is now the subject of an investigation by the Securities and Futures Authority and possibly the Department of Trade and Industry as well as the Serious Fraud Office."[31]

"The infamous "sokaiya" racketeers . . . One group even has its own Internet home page"[32]

"Spanish police . . . seized thousands of [Internet images]. . . in raids on a child pornography and prostitution ring"[33]

"An anti-Semitic text spuriously attributed to Benjamin Franklin has been posted on the Internet by computer-savvy neo-Nazis"[34]

"AT&T . . . filed suit against a[n . . .]Internet access provider . . . alleging that the group defrauded AT&T of millions of dollars."[35]

"Swiss banks Tuesday unveiled a list of pre-1945 account holders who may have perished in the Holocaust . . . on the Internet, breaking with a tradition of secrecy"[36]

"Model Elle MacPherson . . . about two men accused of blackmailing her and threatening to put stolen nude photographs of her on the Internet."[37]

"America Online backed off its plan to begin providing lists of its customers' telephone numbers to telemarketers."[38]

"East Timor has a prominent place on the Internet. There is an ever growing on-line free-for-all where anybody can have an opinion and their version of the facts on the vexed questions surrounding the former Portuguese colony."[39]

"Slovenia's largest bank Nova Ljubljanska Banka has stopped processing payments over the Internet with its Eurocards because of possible misuse."[40]

"An Internet site accused of sympathizing with ETA guerrillas . . . has been "mailbombed" out of existence by an avalanche of electronic mail"[41]

"British insurance group Norwich Union Plc was ordered to pay 450,000 pounds ($754,000) in damages and costs on Thursday over a libelous electronic mail message in one of the first cases of its kind in Britain."[42]

"The Spanish government has asked U.S. cable television network CNN to remove links between its its website and the site of the Basque guerrilla group ETA . . . CNN rejected Spain's request, saying it was standard practice to link up to the website of an organization directly from a story about it."[43]

"A 16-year-old girl who was an outstanding student drowned herself after her parents told her to break up with a boyfriend she had met on the Internet"[44]

"A 14-year-old girl who ran away from her Missouri home was picked up by police in California as she was on her way to visit a boy she had met on the Internet"[45]

WEB COMMERCE AND INFORMATION SOCIETIES

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Abstract

Civilizations are defined by the commercial systems that enable the creation of the physical and intellectual structures of a society. This paper contends that the creation of an "information society" depends upon ubiquitous electronic commerce, and that the lack of widespread, low transaction cost, electronic commerce has prevented the development of a true information society. The paper proposes that the advent of electronic commerce conducted over the World Wide Web, and particularly the adoption of such "Web Commerce" by businesses for procurement, marketing, telework, fee-based distance learning, and sales, is the missing catalyst in the development of an information society. The paper examines "smart community," "smart city," and "information economy" projects in the light of Web Commerce. The paper concludes with suggestions about how smart community projects might be better tailored to accelerate the development of an information economy and of its counterpart, the information society.

Service economies can be distinguished from manufacturing, agricultural, and information economies. A service economy derives the majority of its sales from selling services. Post-industrial societies, such as that of the U.S., rely critically on the information content of services and manufactured goods, but services and manufacturing sales are still more important economically than sales of "pure" information products. The economy of the U.S., nor of any other country, is not yet an information economy. The economy of Hawaii is a clear illustration of the distinction between a service economy and an information economy. In Hawaii, there is virtually no manufacturing. The majority of the gross state product is from sales of services to (i) tourists and government agencies, and (ii) suppliers to businesses selling such services. Yet, Hawaii creates very few information products, such as software, television programming, movies, patents, books, research and analytic reports, and courseware. Hawaii is clearly a service economy, and its society is based on a service economy. Hawaii's former agricultural society was based on its former agricultural economy. How could Hawaii, or other geopolitical entity, become an information society? Simple, by having an information economy. More broadly, civilizations are defined by the commercial systems that enable the creation of the physical and intellectual structures of a society.

An information society by definition has an economy based primarily on the sales of information products. We don't yet know what the physical and intellectual structures of an information society are, since an information economy does not yet exist. Much planning and many attempts have been expended trying to create an information economy, however. These attempts to create information economies have been at the level of communities, cities, and nation-states. All have failed. Why?

Most attempts to create information economies have basically been telework programs, publicity wars between government ministries competing for jurisdictional turf, or hollow pronouncements of industrial policy without regulatory liberalization. The remaining attempts generally lacked a supply of information products, demand for information products, and/or an understanding of infopreneurship. Supply and demand are preconditions of an economy, and infopreneurship is the genesis of an information product.

How does one catalyze supply and demand for information products? Information products, by definition, can be transported over information networks. Therefore, the answer begins with setting the boundaries of the "transportation networks." The transportation network is the Internet. The Internet is global. The catalysis of supply and demand for information products must assume that the potential market is global. The next barrier is transaction cost. How much does it cost the buyer to find out about an information product, to negotiate its purchase (or license), to pay the sales price, to receive the good, and to rescind the transaction if necessary? The only possible system that provides a low transaction cost on a global basis is Web Commerce, that is electronic commerce conducted over the World Wide Web. "Web Commerce" is the use of World Wide Web servers and browsers to market, sell, and settle payments for goods and services. Certain goods, such as a copy of software licensed through a Web Commerce transaction, and many types of services, such as distance learning, can be delivered directly over the Web. The lack of widespread, low transaction cost, electronic commerce has heretofore prevented the development of a true information economy and of its sociocultural result, an information society.

Web Commerce serves and improves all economies, not just an information economy. Web Commerce enables agricultural and manufactured goods to be marketed, sold, and delivered on a global basis and at lower cost. Web Commerce enables one-person corporations to have an international marketing presence and to become exporters. Web Commerce enhances agricultural, manufacturing, and service economies, but it is indispensable to an information economy. The adoption of Web Commerce by businesses in the other economic sectors provides the first platform upon which an information economy can be built, much like manufacturing economies were built upon an agricultural base.

The members of an information economy are the buyers and sellers of information products. Given the specialized nature of information products, many of the markets for information products are locally small, but aggregate into significant global markets. For large or complex information products, e.g., for a license of a television series or a biotechnology patent, only a few potential buyers (licensees) exist. Broadcasting a television series is a service, whereas granting a license of the television series is the sale of an information product. A manufacturer's selling goods that embody a patent is distinguished from the manufacturer's obtaining a license of the underlying patent. Access to niche markets, on a global scale, reinforces the indispensable nature of Web Commerce to an information economy. But the very nature of geographically (even globally) dispersed markets for information products reveals the contradiction inherent in planning a "smart" community, city, or nation-state with the expectation that it will be a self-contained information economy. A smart community may have a computer and Internet access in every house, but not have a single information product generated in the community. The two most common missing ingredients in smart communities to date are (i) a community network (phone and CATV service are not a community network) and (ii) distance learning focused on business skills and infopreneurship. Infopreneurship is entrepreneurship for creating and selling information products and services. A community network is a "community Intranet" (restricted access Website) devoted to the community's institutions and its residents' activities. Given the scarcity of community networks and the complexity of infopreneurship, it is understandable that these two factors have been absent from the attempts at information economies to date, especially from those attempts orchestrated by government agency personnel with no experience in starting and running a business, Website, or network.

Having found previous attempts to build an information economy deficient, how can the deficiencies be remedied? It is the author's practice, in consulting on information technology-based economic development projects (including information economy projects), to focus not on the city or nation-state level, but on the community level. The community level permits personalization of community network design features with the physical community in which the community network and its users reside. The features of the community network are the inducement for residents to use the network. The features must be so compelling that non-computer users will acquire a computer, modem, and the computer skills needed to use the network. Community specific features are password protected for use only by residents.

A community network is the first step in an information economy. A community network creates a virtual community that overlies a physical community. The core feature of a community network is the K-12 school system. Parents will do for their children what parents would never do for themselves, i.e., buy a home computer and access a network. Some parents will move to a community just to gain access to the K-12 features for their children. For community network K-12 content, there are three key sources: the local school board and/or department of education, the state and municipal government, and the community association. The local school board or department often provides adult education classes in addition to K-12 classes. Adult education classes usually include computer and information literacy.

Many other content types are important, but not as critical as K-12 features. From municipal and state governments, the community network can obtain, often in Web page (HTML) format, the various schedules for office buildings and parks, forms and other transaction documents, telephone directories, maps, legislative documents, ride-sharing, laws, employment opportunities, etc. Many, if not most, smart communities are planned communities. In a planned community, the community association will publish its own set of schedules for buildings and recreation centers, forms and other transaction documents, community group directories, maps, community rules, group activities, etc. As each subdivision in a planned community is built, the land developer may even include a computer and a community network account with each new house or apartment sold. The land developer can, in fact, build and lease conduit to infrastructure operators and solicit competitive proposals for operation of the community network. The developer procures the community network, including initial content, and may convey the community network (but not necessarily the conduit system) to the community association like other "common area" assets. A portion of residents' community association dues then subsidizes the operation of the community network until the network is self-supporting through advertising and Web Commerce commissions.

The use of information technology to teach about information technology, and about other subjects that rely heavily on information technology, seems to be a perfect fit of application and infrastructure. In the case of geographically dispersed students (known as "distance learning" or "distance education"), a new information technology generally called "collaborative computing" promises to bring a more universal access to education that ever before. "Collaborative computing" is the concurrent use of videoconferencing, audioconferencing, World Wide Web resources, email, and shared computer applications over one or more digital transmission paths and by persons at two or more locations. Course materials and presentations prepared for collaborative computing-based distance learning ("CCDL") have usually been adapted from traditional classroom materials, but increasingly such materials and presentations are being designed and developed as original works for CCDL. The philosophy and process of designing and developing original works for CCDL is a new and vast topic in itself, a topic that is so new that there are few, if any, formal courses or publications about it, but nevertheless a topic that is vital, if not indispensable, to the development of information economies.

In CCDL, Web-based resources typically include hosting the course textbook, reference works, syllabus, class roster, and administrative materials on a password-protected Web server. Email between faculty and students, and email among students, may be provided through a Web browser or through a standalone email application. Email is used for, among other things, homework submission, return of graded homework, testing, reporting of grades, and notices. Collaborative computing-based distance learning requires datarates that today are higher than V.34 modem access to the Internet. In smart communities, however, Ethernet-speed Internet access is increasingly available, and can be made part of the information technology infrastructure facilitated by the land developer. The modern community network fiberoptic backbone operates at an OC-3 (155 Mbps) datarate and provides Ethernet-speed access lines to end-users, which permits CCDL to include desktop videoconferencing between sites on the community network. The community network provides the workbench upon which authors can create distance learning courseware, an information product. In the future, Internet datarate reservation protocols will permit high-quality desktop videoconferencing or digital video playback at MPEG-1 or better resolution between geographically dispersed videoconferees or between CCDL clients and Webservers.

A provider of distance learning can use Web Commerce to globally market, sell, and collect payment for providing distance learning services. Web Commerce is particularly important in marketing, selling, and settling payments for CCDL, since World Wide Web resources are a central part of collaborative computing-based distance learning. A recent breakthrough in Web Commerce technology, the Secure Electronic Transaction ("SET") standard, provides a means of secure use of credit cards over the Web and for interconnection of such Web-based use of credit cards with the existing, global electronic funds transfer system used for physical credit card transactions. In the opinion of most experts, purchases made using SET-compliant services are safer for all parties than traditional "physical" use of credit cards. For instance, using SET services, the seller does not learn the buyer's credit card number, and the seller does not ship the goods or services until payment is received in the seller's account.

Fee-based distance learning is the second piece of the information economy puzzle. CCDL information products that require Ethernet-speed Internet connectivity can be built and debugged within community networks, and then licensed to other community networks. When general Internet datarates and datarate reservation protocols enable Ethernet-speed connectivity outside the domain of a community network, the market for licenses of the information products will expand accordingly. Fee-based CCDL products can target all ages of students, from K-12 to continuing professional education. Presently, the most lucrative products on a per student basis are continuing education programs for physicians, lawyers, accountants, engineers, and architects. Fee-based CCDL can target the continuing professional education market with attention to niche markets never before possible, since geographically dispersed, highly specialized submarkets can be aggregated and made profitable.

Community networks can also be the workbench for entertainment and procurement products that rely on Ethernet-speed Internet connectivity. Web-based procurement products are rapidly replacing EDI procurement products that required specialized VANs. For those educational, entertainment, and procurement products that do not require as much configuration or customization to reflect the locality of use, Ethernet-speed information products might justify linking large community networks with high-datarate circuits. Initially, such linkage might be by a dialup ISDN PRI, or by multiplexing multiple BRI ISDN circuits, if a full period circuit cannot be cost-justified and datarate reservation protocols are not available. Connecting community networks with high-speed circuits also enables teams in different communities to use collaborative computing to develop information products. Moreover, the availability of advanced CCDL, procurement, and entertainment products only within the perimeters of a community network will attract businesses to relocate or start up within a smart community.

CCDL courseware on infopreneurship must be part of the content available on a community network. Infopreneurship spans a vast spectrum of subject matter, from programming languages to digital video, multimedia licensing, venture capital, "MBA core courses," and managing software developers (aka herding cats). From among the students in the virtual university who enroll in infopreneurship courses will come the leaders of technology start-up businesses. In a sense, the author's approach to building an information economy borrows heavily from the orthodox "university spin-off" model proven in Silicon Valley, Route 128, Austin, and Research Triangle Park. In place of the physical communities in Palo Alto, Cambridge, Austin, or Raleigh/Durham, there are virtual universities serving student populations in linked community networks. Virtual corporations and other information technology start-up businesses will be spun-off from the virtual university. To use a biological model, the solitary smart community network is like a solitary *Volvox*, a single-celled alga or flagellate (biologists differ over whether *Volvox* is a plant or an animal); linked community networks are like a *Volvox* colony, in which groups of contiguous cells actually become specialized organs of the larger colony. From linked community networks come ever more efficient production of information products as some smart communities develop specialties. The theory of competitive advantage would apply to linked smart communities just as it did to nation-states using sailing ships.

This paper has distinguished an information economy from a service economy, reviewed the ill-fated attempts to build information economies to date, and proposed community networks as the sine quo non of an information economy. Community networks enable the development, enhancement, and licensing of collaborative computing-based distance learning, entertainment, and procurement products. As virtual communities form around virtual universities that offer CCDL, infopreneurs will create spin-off businesses and additional information products. To attract residents and businesses, the content and network access of smart communities should always offer better CCDL and higher datarates than outside the smart community. When sales from information products in a given physical community exceed sales from services, manufacturing, or agriculture, the first true information economy will be born.

A New Model of Internet Regulation: Promoted and Regulated Value-Added Service

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1. ABSTRACT

In most nations the Internet falls into the category of value-added services which are not heavily regulated under the global de-regulation trend. However, the growing significance of the Internet in our economic, social, and political life has allured some governments to step back by establishing new regulatory frames on the Internet. Taking China as an example, this paper examines how a new model, promoted and regulated value-added service, is designed and implemented by the Chinese government to nurture and regulate its Internet.

2. INTRODUCTION

As the Internet becomes more popular worldwide, China has also decided to embrace this new and powerful information medium. China's Internet began its growth in 1994. By early 1997 the four dominating national interconnecting networks, ChinaNET, ChinaGBN, CERNET, and CSTNet, had about 600 access networks and 80,000 users.

While the Internet's economic benefits are obvious, the expansion of China's Internet does bring in political and social challenges, given the big difference between Chinese and Western nations' social and political systems. The global and open nature of the Internet makes it possible and easy for Chinese users to access to Western materials on the Internet which are controlled and restricted by the central government.

Fortunately, China has not shut down its Internet to avoid the inevitable social and political challenges. Instead, China has decided to tighten its content access and service operation regulations to minimize the social and political drawbacks while continuing to expand its Internet. The Internet's economic potential is certainly the driving force for this open approach. This policy has also demonstrated China's desire to maintain connection with the global community.

The Internet has evolved into the most powerful global medium the world has ever known. The Internet is capable of functioning as a means to publish, distribute, and broadcast information across national boundaries. Controlling content access is not only a technical challenge, but also a legal and political challenge. It is widely argued that governments, including the Chinese government, will have a tough time realizing their goals of controlling content access.

This paper first discusses the economic benefits and political and social concerns brought by the expansion of China's Internet. It then explores Internet growth in China and examines China's regulations on Internet service provision and content access.

3. INTERNET AS A SUPER COMMUNICATION MEDIUM

The Internet has obtained its popularity around the world in recent years and it emerges as the most powerful global medium the world has ever known with three unique features - the combined functions of traditional communications media, the non-existence of central control, and the broken national boundaries.

The Internet combines elements of telecommunications, broadcasting, and publishing into a new medium for communications[1]. Powered by current computing capabilities, the Internet has potential to provide full-range communications services including information services, on-line commerce, and entertainment services. E-mail and emerging Internet phone and Internet video systems stand to supplement and to enhance the traditional communications functions provided by the PSTN. Web sites and FTP sites enable users to search and collect information for work and leisure purposes, while providing a channel for owners to publish and distribute academic, administrative and commercial materials. Usenet, listerservers, and electronic bulletin boards allow users to broadcast and receive messages.

Secondly, the Internet consists of numerous independently administrated networks, which are interconnected according to TCP/IP network protocols. The unprecedented open and decentralized nature of the TCP/IP protocols leads the Internet to a position without any centralized control and ownership. Every participant is part of it and owns a fraction of it. This decentralizing feature ensures a robust medium with unlimited expanding potential to include any computer network in the world.

Thirdly, TCP/IP network protocols have enabled the Internet to expand into a global network that encompasses national and regional networks no matter where they reside. The national boundaries, which are often obvious for other media such as telephone and television, have been blurred, if not totally broken[2]. The Internet therefore functions as a remarkable bridge across cultural and geographic boundaries and emerges as a prominent media that facilitates communications amongst societies with different socio-economic and political backgrounds.

As a new, revolutionary and powerful medium, Internet brings opportunities to both developed and developing nations, though some risks and uncertainties come along with the new medium. Different nations may take their own path to embrace or to discard this new medium because of different social, political, and economic environments. As argued in the following sections, China has chosen to expand its Internet while trying to minimize its drawbacks.

4. WHY THE INTERNET IS PROMOTED IN CHINA

4.1 THE DRIVING FORCE - THE INFORMATIZATION OF NATIONAL ECONOMY

Since China designated economic development as its national top task in 1978, China's economy has been experiencing impressive growth rates. The continuing double digit growth rates in the early 1990s made the Chinese economy the fastest growing in the world. China has been struggling to formulate its strategies in order to sustain the high growth rates and to grow into a super economy. China's past economic growth mainly comes from the labor-intensive manufacturing sectors. Recognizing the shift of global economy toward information intensive sectors and the potential impacts of information sector on the growth of other economic sectors, promoting the informatization of China's economy has been agreed upon as the future strategy. As argued by Youjing Zheng, "Informatization is the foundation for China's economic modernization; information resources is one of the most basic and important inputs for modern economic development; information industry should become the fundamental sector of China's economy."[3]

While the serious academic discussion on informatization began in 1986, the idea was carried into large-scale initiatives in early 1990s. In 1993, Chinese government launched its "Three Golden Project" which is often regarded as China's NII (National Information Infrastructure) initiative. The goal is to set up a state public economic information network and to establish data networks for banking and Customs services.[4] The "Three Golden Projects" were quickly expanded into the "Multiple Golden Projects" in the following years, aimed at setting up data networks for all the major industry sectors. Those networks have composed the major part of China's Internet while they often serve as government agencies' intranets.

The implementation of informatization initiatives calls for institutional support from China's central government. China's State Council established its Joint Conference on Economic Informatization (JCEI) to coordinate the efforts on establishing information networks by ministries, agencies and large corporations in 1994. The interim JCEI was promoted to the State Council's Leading Group for Economic Informatization in April 1996.

4.2. FROM "OPEN DOOR" TO "INTEGRATION" - THE NECESSARY INTERNATIONAL CONNECTION

Recognizing that an isolated economy could not lead to substantial growth, one of the integral part of China's 1978 economic reform initiative is to open China's door to the Western world. The infamous policy of "combining trade with technology import" led to tremendous information, as well as material, exchanges with the rest of the world.[5] The "combining trade with technology import" policy is meant to import foreign technologies, know-how, and management skills to help the development of China's indigenous industry, while giving up certain domestic market shares to foreigners. This is rooted in the ancient belief that China could develop an advanced self-reliant economy by importing foreign technology and capitals but not joining the global economic club.

In recent years, Chinese scholars have spoken of the difficulties of separating indigenous industry from the global industry.[6] These scholars accept the concept of economic globalization and argue that China should try to integrate its economy into the global economic system rather than insistently trying to promote indigenous industry. Whether or not the integration elements have been publicly incorporated into China's formal policy, the steadily growing capital investment in China by foreigners and the growing import-export figures suggest the trend of China's integration with the global economic system.

Those foreign links have to be established, maintained, and expanded by constant communications across national borders. Telephone calls and faxes have functioned as the dominating media in the past years. The coming years need more sophisticated systems to sustain the communications. The Internet and other information networks seem to be the perfect choices. EDI (Electronic Data Interchange) has been promoted in order to allow Chinese firms to trade effectively and efficiently with foreign partners. The pervasive Internet connection with the global community is believed to further China's efforts to integrate its economy into the global economy.

The global Internet connection certainly stands to bring in foreign information which might jeopardize China's political and social systems. However, the economic allurement is so high that China has chosen to live with the risks. In addition, measures have been proposed to minimize the social and political risks, such as formulating tight service provision regulations and implementing content filtering and blocking.

4.3. INFORMATION INDUSTRY - THE PROMOTED AND LUCRATIVE SECTOR

In recent years, the information industry has experienced strong growth in many nations including China. The total revenue of China's posts and telecommunications operator, the MPT, has been enjoying a 40% to 50% annual growth since the late 1980s, as shown in Table One. In addition, the information industry has been chosen by the Chinese government as one of the two key sectors to sustain China's economic development in the next century.[7] This promising future attracts stake holders to support the Internet and other information industries.

Table One: Total Sales of China's Posts & Telecommunications Sector

Year	1988	1989	1990	1991	1992	1993	1994	1995
Total sales (billion Yuan)	5.40	6.48	8.17	20.44	29.09	46.27	68.82	98.88
Annual growth		20%	26%	150%	42%	59%	49%	44%

Source: China annual statistic yearbooks.

At the national network level, China's Internet is promoted by four information-related government agencies, the Ministry of Posts & Telecommunications (MPT), the Ministry of Electronics Industry (MEI), the State Education Commission (SEC), and the Chinese Academy of Sciences (CAS). They are the only four agencies who are licensed to DIRECTLY connect their national networks to the global Internet. Each agency has its own gains from the expansion of Internet in China.

The MPT views China's Internet as its another cash cow. It is expected to make a profit both through its own Internet business, ChinaNET, and by providing telecommunications facilities to other Internet operators and users. The MEI wants to share the promising profit through its own service provider, ChinaGBN. More importantly, the MEI's core business, microelectronics and computers, would certainly gain a great deal from the Internet expansion by providing hardware and software. The

State Education Commission and the Chinese Academy for Science contend that the pervasive Internet would enhance their ability to conduct research and education, while keeping their leading position of R&D in information technologies including Internet is one of their top agendas.

At the ISP level, entrepreneurs, government units, and even foreign interests have taken the Internet as a great opportunity for them to share the promising sweet pie of China's information sector. Internet services are classified as value-added services in China, which allows any legitimate corporation to apply for the operating license. Foreign firms are still prohibited from operating Internet services, as with other telecommunications services. However, foreign capital has flowed into the service operation through indirect channels. While most ISPs only provide access services, some of them have created and maintained their own contents in order to grow as on-line service providers. The number of ISPs are growing exponentially, for example, there were about 32 ISPs in Beijing by the middle of 1997.[8]

Besides the above three major driving forces, Chinese users are enthusiastic to adopt the Internet, as with many other new communication technologies. There are, however, some serious barriers hindering the expansion of China's Internet. The central government's worry of losing information control is the most publicized threat. The poor telecommunications infrastructure and high leasing prices, the low computer penetration rate and limited English language knowledge among users, and the sky-high usage charges by ISPs because of their high operating costs are other significant barriers.

5. INTERNET GROWTH - THE CHINESE PATH

5.1. DELAYED, BUT IMPRESSIVE, GROWTH RATE

China's Internet began its growth in 1994. While the user base is still relatively small, the annual growth rate is impressive. There are no accurate statistics about China's Internet subscribers because of the lack of a tracking system and official statistics. In addition, many accounts are shared by a group of users, allowing them to avoid the high account registration and installation charges. Table Two presents a conservative estimation based on several sources. The total users jumped to 80,000 in 1996 from 1,600 in 1994. The annual growth rate is always over a few hundred percent.

Table Two: Internet Subscribers in China.

Year	1994	1995	1996	1997 (projected)	2001 (projected)
No. of Subscribers	1,600	6,400	80,000	250,000	2,700,000
An. Growth Rate		300%	1150%	212.5%	

Sources: ChinaNET, ChinaGBN, CERNET, and others.

Another more systematic and accurate indicator is the increased number of China's Internet hosts. According to China Internet Network Information Center (CNNIC), which runs the domain name registration under the top domain .cn, China's Internet hosts have increased from 325 in July 1994 to 19,739 in January 1997. An over 400% increase occurred in early 1996, as shown in Table Three.

Table Three: Internet Hosts in China.

Date	7/94	1/95	7/95	1/96	7/96	1/97
Host Number	325	569	1,023	2,146	11,282	19,739
Semi-annual growth rate		75%	80%	110%	426%	75%

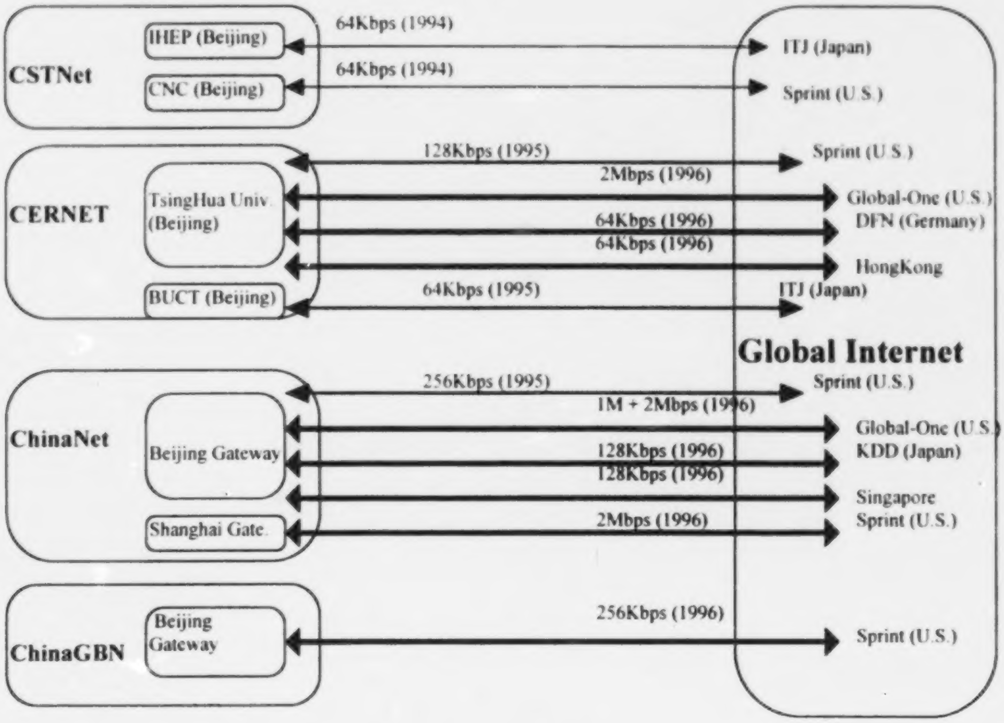
Source: China Internet Network Information Center (CNNIC).

Compared with the United States and other developed nations, China's Internet lags a few years behind. However, China's growth rate is as impressive as what happened in those developed countries.

5.2. INTERNATIONAL LINKS - STEADY IMPROVEMENT

China's international links to the global Internet has shown another impressive increase which has strongly demonstrated China's efforts to interconnect its internal Internet to the global Internet. Starting with two 64Kbps links in 1994, China successfully managed to increase its total capacity to 576Kbps in 1995 and 8216Kbps in 1997. The links have reached a wide variety of locations including the United States, Japan, HongKong, Singapore, and Germany. Figure One has documented the detailed evolution of those international links.

Figure One: China's International Links in 1994, 1995, and 1996


CSTNet
IHEP (Beijing)
CNC (Beijing)
64Kbps (1994)
64Kbps (1994)
ITJ (Japan)
Sprint (U.S.)
CERNET
TsingHua Univ. (Beijing)
BUCT (Beijing)
128Kbps (1995)
2Mbps (1996)
64Kbps (1996)
64Kbps (1996)
64Kbps (1995)
Sprint (U.S.)
Global-One (U.S.)
DFN (Germany)
HongKong
ITJ (Japan)
Global Internet
ChinaNet
Beijing Gateway
Shanghai Gate.
256Kbps (1995)
1M + 2Mbps (1996)
128Kbps (1996)
128Kbps (1996)
2Mbps (1996)
Sprint (U.S.)
Global-One (U.S.)
KDD (Japan)
Singapore
Sprint (U.S.)
ChinaGBN
Beijing Gateway
256Kbps (1996)
Sprint (U.S.)

Sources: ChinaNET, ChinaGBN, CSTNet, CERNET.

The costs of international leased lines are relatively more expensive in China than in most developed nations. Taking a leased line between China and the United States as an example, the Chinese operator pays 147,000 Yuan (about US$17,900) to China's MPT and 81,000 Yuan (about US$9,880) to the US carrier per month for one 256Kbps leased line.[9] This adds up to a US$27,780 per month charge. For a 2Mbps leased line, the Chinese operator has to pay about US$95,100 per month to the Chinese and the US carriers. This is a huge burden to Chinese interconnecting network operators who transfer the costs to ISPs and end users in most cases. The high charges are also one of the major barriers to the future capacity increase of China's international links.

5.3. DOMESTIC NETWORK INTERCONNECTION AND DOMAIN NAME REGISTRATION

China's Internet is constructed of four previously separated national networks. ChinaNET, ChinaGBN, CERNET, and CSTNet all have their own national backbones which were not interconnected initially. An email from the ChinaNET to a receiver on the CERNET, for example, was often sent to Japan or United States. The email would be re-routed back to China via the international link to reach its final destination. China's national Network Access Points (NAPs) are still in planning. However, previously isolated networks have been directly or indirectly connected via domestic links.

Meanwhile, China has finally assigned the Computer Network and Information Center (CNIC) of the Chinese Academy of Sciences to run China's domain name registration. The authorization, signed by the State Council's Leading Group for Informatization, grants CAS's CNIC the operation right to run CNNIC(China Internet Network Information Center). CNNIC is responsible for the domain name registration under the top domain .cn. However, the CERNET has been granted the right to register domain names under the .edu.cn sub-domain. By doing this, China has formally taken over the domain name registration rights of .cn from the Asia-Pacific Network Information Center located in Japan.

6. "REGULATED" VALUE-ADDED SERVICES

According to China's telecommunications regulation, any legitimate domestic corporation could operate value-added services including the Internet by registering to the MPT or to a MPT's local bureau when it is a local operation.[10] However, the concerns of safety, content control, and redundant and overlapping networks have pushed China's Internet into a *REGULATED* value-added service.

On February 1, 1997, State Council issued its Order No. 195 to govern China's Internet. This Order, entitled "Interim Regulations on International Interconnection of Computer Information Networks in the PRC", was slightly revised on June 3, 1997 and has laid down the following rules on China's Internet.[11]

- The State Council's Leading Group for Informatization is responsible for the coordination and decision-making on the important issues of the Internet.
- Only four agencies, the MPT, the MEI, the SEC, and the CAS, are authorized to establish and operate Interconnecting Networks (INs) which run direct links to the global Internet through international leased circuits.
- All the direct links by the four government agencies to the global Internet must be connected via MPT's international gateways. No one may establish or utilize other means to gain access to global Internet.
- All the ISPs who run Access Networks (ANs) should apply for operating license and gain international access from one of the four interconnecting network operators.
- All Internet users have to register with the local bureau of the Ministry of Public Security as well as with their ISPs. Users will also fill out a network access responsibility agreement pledging not to threaten state security or disclose state secrets through the Internet.

The regulations have added many new rules on China's Internet, compared with other value-added services. Figure Two illustrates this regulatory frame in detail.

6.1. A NEW REGULATED FRAME - COMPETITION UNDER MONITORING

Under the old regulatory regime, the MPT was the official regulator which made the policy and handled the registrations on the provision of various value-added services. State Council's interim regulations on China's Internet has created a new regulatory structure regarding Internet operation.

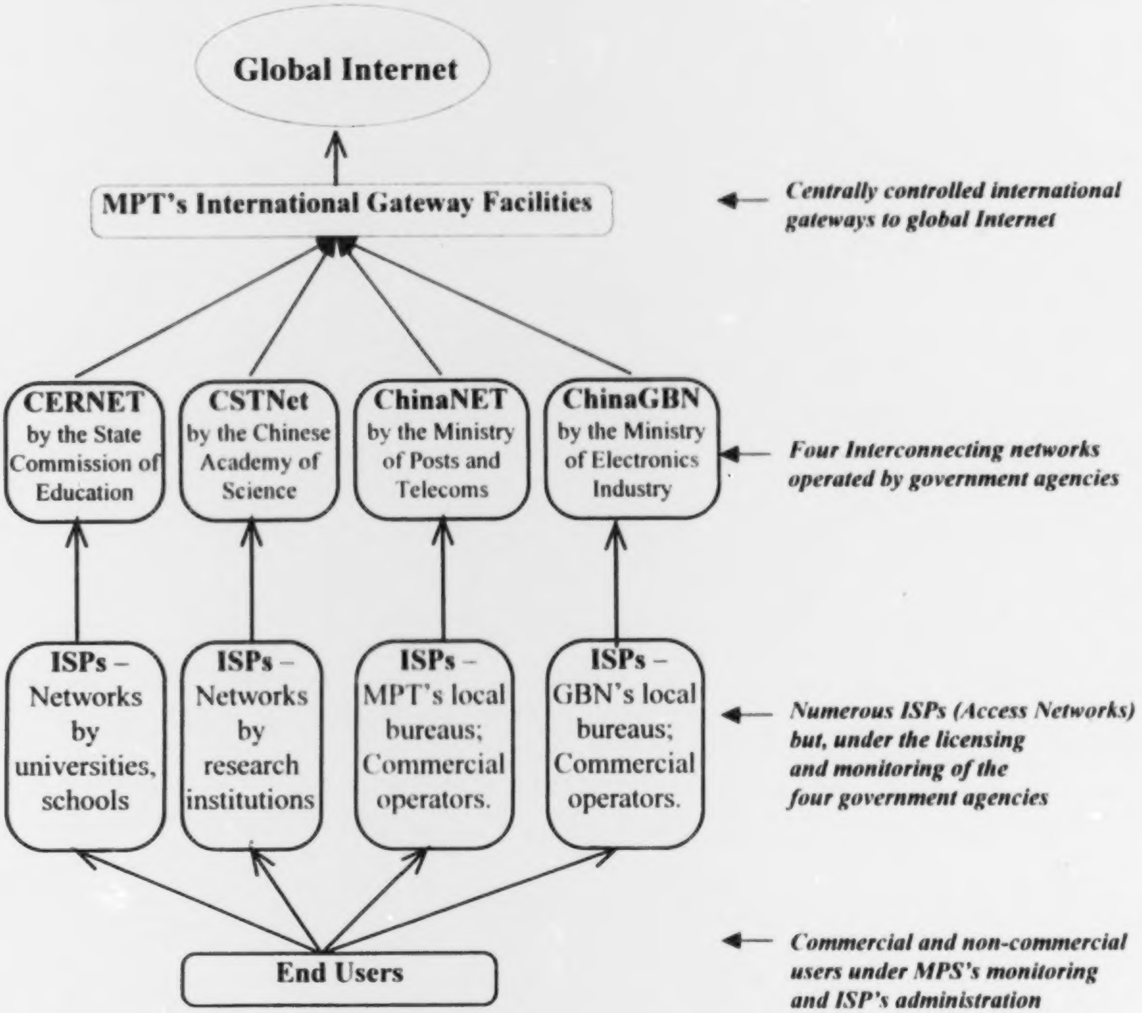
The State Council has chosen a new, higher level organization, the State Council's Leading Group on Informatization, to be responsible for all the policy-making decisions. However, the leading Group will not handle license applications, nor will it actually run the operations. The telecommunications regulator and operator, the MPT, has been assigned as a Internet service operator and a registrar, together with other three government ministries and agencies, the MEI, the SEC, and the CAS. All the ISPs have to apply for operating licenses from those four registrars.

This new regulatory regime presents a model which blends the competitive nature with centralized controlling.

- A new regulator, the Leading Group, has been created. The Leading Group is not involved in operation. This has fulfilled the goal of separating regulation from service operation.
- The rights of top level operation have been granted to four agencies, rather than one. This has assured competition of China's Internet services.
- The ISPs are required to obtain licenses from the four operators, which are government

agencies. The legacy of government control is partially kept under the new structure.

Figure Two: The Regulatory and Networking Frame of China's Internet


Global Internet
MPT's International Gateway Facilities
Centrally controlled international gateways to global Internet
CERNET by the State Commission of Education
CSTNet by the Chinese Academy of Science
ChinaNET by the Ministry of Posts and Telecoms
ChinaGBN by the Ministry of Electronics Industry
Four Interconnecting networks operated by government agencies
ISPs – Networks by universities, schools
ISPs – Networks by research institutions
ISPs – MPT's local bureaus; Commercial operators.
ISPs – GBN's local bureaus; Commercial operators.
Numerous ISPs (Access Networks) but, under the licensing and monitoring of the four government agencies
End Users
Commercial and non-commercial users under MPS's monitoring and ISP's administration

Source: Compiled and copyrighted by Zixiang (Alex) Tan.
GBN: Golden Bridge Network

6.2. NETWORK CONSTRUCTION - UNDER GOVERNMENT CONTROL

The network structure of China's Internet is shaped by the regulatory frame. All the four top-level operators are permitted to construct their own national networks and to provide networking services to ISPs. More importantly, they are allowed to set up direct international links to the global Internet.

However, all of China's direct international links are required to go through MPT's international gateways. No one is officially authorized to set up international links through other carriers or by other means. This is partially a recognition of MPT's monopoly on international traffic. In addition, this arrangement paves the way for implementing content control.

ISPs could certainly set up their own local networks. There are no specific rules which limit ISPs' efforts to expand their regional or even national networks. However, ISPs are not allowed to set up their own direct connection to the global Internet. They are required to get global access through one of the four top-level operators. Lack of the direct global links may put ISPs' expansion under control.

6.3. CONTENT CONTROL - A KEY ISSUE

One of the key goals of the State Council's regulations on the Internet is to control content. As argued in the previous section, the pervasive Internet allows Chinese users access to all the on-line materials inside and outside China. Many of those materials are either deemed indecent by Chinese standards or are under control and restriction by the central government. This scenario poses a serious threat to China's political and social system.

China has carefully structured its content control measures through institution arrangement, network control, and user regulations. At the international cross-road, all the direct links are required to go through MPT's gateways, which retain a physical point to set up a national firewall. Some experimental exercises have been conducted which aim to block Chinese users from accessing certain Western web sites by adding filtering and blocking software at the gateways.[12]

At the service provision level, four government agencies have served as registrars to watch the ISPs. Any ISP is in danger of losing its operating license if convicted of not cooperating in enforcing content control.

Another important level of implementing content control is the creation of regulations regarding end users. These are implemented both by the ISPs and by the Ministry of Public Security (MPS). All Internet users are required to register with the MPS bureau in their locality by filling out the Police File Report Form. New users also need to sign a Net Access Responsibility Agreement in which they pledge not to threaten state security, reveal state secrets or transmit obscene or pornographic materials.

The three levels of regulations were intended to keep the content access under Chinese government's control. The implementation of the three-level content control may be problematic in reality because of the limited financial resources and the lack of skilled engineers and lawyers. The social and economic costs of the content control regulations need to be further tracked.

7. THE FUTURE AND CONCLUSION

China's Internet has been evolved into a regulated value-added service. The regulatory frame has incorporated competitive mechanisms while keeping some legacy of China's traditional central government controlling. This is a unique regulatory model in the world. The big question is whether the regulation structure will promote or hinder the expansion of China's Internet.

The data of the past two to three years indicate a positive growth curve for China's Internet. However, the Internet in China is still a service for elite users. Only a small portion of businesses have started to use the Internet in their operation. The impacts of this unique regulatory model remain to be seen.

8. ENDNOTES

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[1] Morris, M & Ogan, C. (1996). The Internet as Mass Medium. *Journal of Communications*. 46 (1), pp39-50.

[2] Johnson, D & Post, D. (1996). Law And Borders--The Rise of Law in Cyberspace. http://www.cli.org/X0025_LBFIN.html.

[3] Zheng, J. (1993). Informatization and China's economic development. In Li, J Komatsuzaki, S. Zheng, Y. & Russel, P. eds. Informatization and Economic Development, pp45-53. Beijing: Social Science Literature Press, 1993 (in Chinese).

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[4] Mueller, M. and Tan, Z. (1997). China in the Information Age: Telecommunications and the Dilemmas of Reform. CSIS/Praeger, Washington D.C./Westport CT, 1997.pp52.

[5] op cit 4.

[6] Wang, Z. (1994). Investing in China by Multinational Corporations. Beijing: China Foreign Trade Press.

[7] Lu, Q. (1997). Development Directions for China's Informatization. *Internet Forum* (in Chinese), June 1997. Http://www.ihep.ac.cn/magzine/97/6/lq1.htm.

[8] Barme, G. & Ye, S. (1997). The Great Firewall of China. *Wired*, June 1997, pp138-150.

[9] Lei, L. (1997). The focus: telecommunications charges. *Internet Forum* (in Chinese), May 1997. Http://china-window.com/97/5/lnw.htm.

[10] op cit 4, pp 77.

[11] Tan, Z., Mueller, M. and Foster, W. (1997). China's New Internet Regulations: Two Steps Forward, One Step Back. *Communications of The ACM*, December 1997. Forthcoming.

[12] Yurcik, W. & Tan, Z. (1996). The Great (Fire)Wall of China: Internet security and information policy issues in PRC, in the Proceedings of the 24th Telecommunications Policy Research Conference, Soloman, MD, October, 1996.

Killer Applications For Internet/Internet2 And Their Impact To The Telecommunication Industry

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Abstract

Internet has been rapidly advancing with technological components and useful applications. In only a few years' time, it evolved from a principally academic research network to a commercial network poised as the network solution for information service and various electronic commerce. Recently, a major movement initiated mostly by the academic institutions is calling for the development of a high bandwidth (minimum of 155 Mb/s) national network called Internet2 to be completed by 2001. These Internet developments on the one hand are prompted by the fever of application growth visible on the current Internet and on the other hand are searching for the major killer applications which can justify the investments and the development efforts of the next generation Internet. This phenomenon should be quite familiar to the telecommunication industry; for example, when telephone companies and cable companies were making their investments in network speed and capacity they were looking for their major killer applications to bring back healthy returns for their investments. One recalls that the Video-on-Demand was touted as the killer application to warrant the investment of ATM network and switching but it soon became clear that video content creation would take time to produce and the consumers would take even longer time to accept the VOD as a major application by willing to pay a fair price for it. Why should Internet2 be different in finding its killer applications? Will Internet2 be financed with no return in mind? If the answer is yes, what will be its impact to telecommunication industry? If the answer is no, what are the killer applications for Internet2 then? What are these applications' impact to the telecommunication industry? This paper attempts to address the above questions via a historical review of the past events and an analytical deduction of current happenings. A number of potential real killer applications will be discussed in contrast to the VOD application in the light of justifying the investments that have to be made in order to enable the applications as well as in the light of analyzing their impacts to the telecommunication industry.

I. Introduction

Internet as a network of networks can be traced back to its embryo as ARPANET (1) commissioned in 1969 and later its academic origin as the NSFNET (2) with 56 Kb/s backbone created in1986. From the application point of view, it evolved from the initial network for supporting military research into a network principally used for e-mail (invented in 1971 by Ray Tomlinson (3), file transfer and World Wide Web information service (invented in 1992 by Tim Berners Lee. (4). Of course, the latter application category, consisting of numerous innovative applications in the area of advertising, information search, electronic order, public service, etc., only mushroomed into a information boom in the past three years.

The rapid growth of Internet (5), its black-out (6) and the proposal of Internet2 (7) have posted a clear warning signal to the telecommunication industry, at least for the network operators, service providers and the equipment vendors. The present Internet and the future Internet2 will have a great impact to the telecommunication industry. The industry largely concerned with telephony business before is going through business transformations which involve mergers and strategic changes. However, it is not entirely clear that the decisions derived from a "telephony vision" is the correct one since many new applications may still emerge.

This paper intends to take an application-driven view to examine whether there are certain critical applications emerging in the

Internet and/or Internet2 which will have a very significant impact to the telecommunication industry. In the next section, we first review the history, goal, status and plans of Internet2 with which to set the background for the discussion to follow. In Section III, we probe the telephony view versus some other visions. We introduce a number of applications which may be considered as Killer Applications potentially having very significant impact to the telecommunication industry. We then analyze these applications and their network requirements from network architecture, traffic volume and operational procedure points of view. This analysis and discussion is presented in Sections IV and V. Concluding remarks are given in Section VI followed with acknowledgment and references.

II. Status of Internet2

A. History

Internet2 (7) is a proposal from academicians to build an advanced network for academic and research use with the hope to advance the network technology and accelerate the development of several key classes of applications. The concept of an advanced Internet network infrastructure has also been promoted by Vice President Al Gore known as the Next Generation Internet (NGI) (8). On October 10th, 1996, President Clinton released a background paper with his speech announcing the Clinton-Gore NGI which made a clear definition for the goal of NGI: "demonstrate new applications* that meet important national goals and missions (with higher-speed and more advanced networks)" *(scientific research, national security, distance education, environmental monitoring and healthcare). Although they have similar objectives, but the approach and momentum behind them are not the same. The latter is a promotion calling the nation to think and advance ahead in Internet and the former is an academic consortium committing some resources and inviting industry to support and participate with NSF endorsement and backing.

At a meeting in Chicago in October, 1996 (7) exact time and sequence of events are the research topic for historians), representatives of thirty-four universities agreed unanimously to endorse the goals of the Internet2 project, committed their institutions to finding the resources necessary to participate in the project, and pledged initial funding to enable planning efforts to proceed without delay. Support for the project from the academic community has grown quickly. To date, over one hundred universities have become members of Internet2. Each member university has pledged substantial staff resources and financial support for the duration of the project. Associate members and affiliate members were later defined to invite broader academic and industry participation.

In most respects, the partnership and funding arrangements for Internet2 will emulate the successful NSFnet example as a joint academia and government collaboration effort. The federal government will participate in Internet2 through the Next Generation Internet initiative and related programs. Thus, Internet2 and NGI may be viewed as one movement with the same overall objective but with some sub-objectives to be interpreted and carried out by different organizations and institutions.

B. Status

In the Internet2 movement, another goal is to join with corporate leaders to create the advanced network services necessary to meet the requirements of broadband, networked applications. Industry partners are urged to work primarily with campus-based and regional university teams to provide the service and products needed to implement the applications defined and to be developed by the project. Major corporations such as Ameritech, Cisco Systems, Digital Equipment Corporation, IBM, MCI, Sprint and Sun Microsystems have already pledged their support for Internet2. Additional support for Internet2 will come from collaboration with non-profit organizations working in research and educational networking. Many affiliate organizations already committed to the project. By promoting cooperation among these organizations, government agencies and private industry, Internet2 will effectively leverage research funding, accelerate the development of campus networks, and create new standards and technologies urgently needed for advanced research, and eventually, by all Internet users.

C. The Goals of Internet2

The official goals of Internet2 (7) are stated as follows:

First and most importantly, creating and sustaining a leading edge network capability for the national research community.

Second, directing network development efforts to enable a new generation of applications to fully exploit the capabilities of broadband network, media integration, interactivity, real time collaboration to name a few.

Third, integrating the work of Internet2 with ongoing efforts to improve production Internet services for all members of the academic community. A major goal of the project is to rapidly transfer new network services and applications to all levels of educational use and to the broader Internet community, both nationally and internationally.

D. Project Plan

The project will be conducted in phases over the next three to five years, with initial participation expected from leading research universities, a number of federal agencies, and many of the leading computer and telecommunications companies. In the initial project phase, end to end broadband network services will be established among the participating universities. On a parallel basis, teams of university faculty, researchers, technical staff and industry experts will begin designing applications. It is expected that within eighteen months, "beta" versions of a number of applications will be in operation among the Internet2 project universities. The key application examples of Internet2 are: Learningware, Digital Libraries, Tele-immersion, and Virtual Laboratory. The progress of the project is achieved and measured through technical working groups.

E. Internet2 Architecture

Fig. 1 shows the architecture of the Internet2. A minimum network speed of 155Mb/s is assumed. Internet2 is a network interconnecting a collection of very high speed regional gigapop centers.

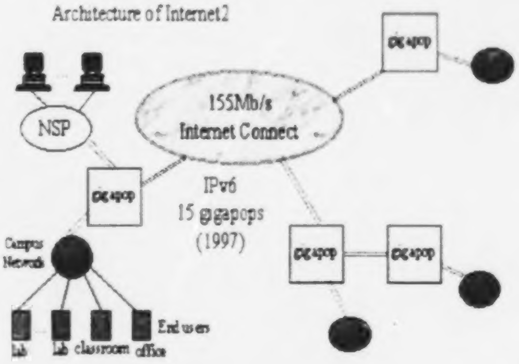

Fig.1. Architecture of Internet2

The key new element in this architecture is the gigapop (for "gigabit capacity point of presence") – high-capacity, state-of-the-art interconnection point where Internet2 participants may exchange advanced services traffic with other Internet2 participants. Campuses in a geographic region will join together to acquire a variety of Internet services at a regional "gigapop". Each campus will install a high speed circuit to its chosen gigapop through which it will gain access to commodity Internet services as well as advanced Internet2 services. The gigapops will then join together to acquire and manage connectivity among themselves, in an organization whose structure and legal form remain to be determined. Potentially there could be a wide range of services available at the gigapop, limited only by the economics of the market and the absolute priority and insulation of Internet2 services.

III. Killer Applications of the Twenty First Century

The global telecommunication industry is basically a telephony industry. The computer industry has been concerned mainly with local area network communication up till the emergence of the Internet. The cable industry was preoccupied with entertainment applications until the new telecommunication Act that opened up the telephony playing field and the rise of the Internet. The fever of video-on-demand a couple of years ago did trigger some awareness of network requirements and some competitive analysis among the cable and telephone companies, but cooled off due to the lack of content or slow development of content for VOD. The telecommunication companies are positioning themselves to gain local access, market share of subscribers and back-bone connectivity, but are they getting ready to meet the demand of the twenty first century killer applications projected by Internet2? How would the Internet2 initiative (achieving 155Mb/s network) impact the telecommunication industry?. The answers to these questions ought to influence the planning and strategic alliance of telecommunication companies.

We present here a few applications which in our view may become dominant telecommunication applications for Internet for the next century. These applications do not have the content issue as in the VOD case. We feel that it is important for the telecommunication industry to understand these applications and their network requirements. These applications already exist on today's Internet, however, they will be enhanced and scaled up with the arrival of Internet2.

A. Global Collaborative Internet Interactive Education

Internet Interactive Learning has been recognized as an important education methodology offering supplemental and complimental advantages over the traditional classroom teaching or learning (including the high cost of distance learning in video classroom). Many universities have started experimental projects on Internet Interactive learning. (9-12). PRIDE has taken a more holistic view of Internet Interactive Learning and developed a comprehensive system called I-CARE. I-CARE (12-14) is a system designed to provide all necessary functions and tools for education administration, courseware preparation and teaching and learning. We discuss here an application concept of Global Collaborative Education (GCE) based on Internet Interactive Learning utilizing a comprehensive system such as I-CARE. This application not only is a justified academic application, but also is a challenging application to Internet2 and the telecommunication industry since it will utilize the full capability of Internet2 when fully scaled up. Fig. 2 depicts a network infrastructure of GCE and a simplified system architecture of I-CARE.

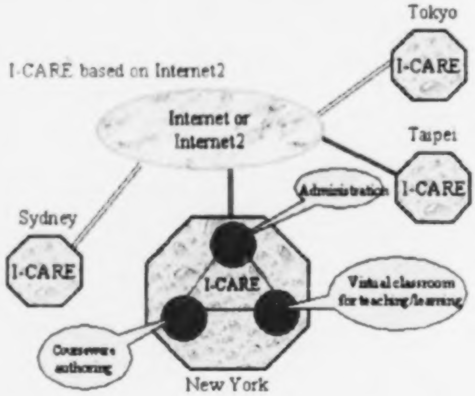

Fig. 2. GCE and I-CARE based on Internet2

The concept of GCE is very simple, that is a number of educational institutions will collaborate and offer educational programs jointly to students distributed locally or globally. Each institution will set up a course catalog of its selection delivered by Internet Interactive learning for the collaborative program. The combined program catalog is offered to students globally. The students may earn a degree or certification from the joint program or from an individual institution if the student's study fulfills its academic requirement. At this moment, this concept is being formulated between a number of institutions. As the policy differences between institutions and countries are settled, this concept can evolve very quickly to become a true global-scale education program involving thousands of institutions.

Internet Interactive Learning today is mostly limited to asynchronous interaction involving text and images. However, that is principally due to the network bandwidth limitations of the Internet today not because of any lack of audio and video technologies. In the Internet2 environment, these GCE Internet Interactive Learning programs certainly can utilize the full range of multimedia and the multicasting, narrow casting and/or broadcasting techniques for teaching and learning. Hence, with full multimedia, functions in a sealed up mode, GCE may become a major application of Internet2 and the telecommunication industry.

B. Internet Real-time Conference

Academic researchers and educators participate in many technical conferences a year. Their interactions with various fields of industry extend and mingle their activities with professionals in various industries. It has been recognized that the conference activities although valuable are very costly to the academic institutions and R&D organizations. Even industry which has traditionally allocated more funds for marketing has felt the cost pressure from conferences and exhibits. The author has proposed the concept of Internet Real-Time Conference (IRC) at the early days of Web emergence (15). Today's network capability is limiting its full range of applications involving multimedia and real-time synchronous technologies. However, its benefits of cost-saving and more effective information exchange for the mass conference attendees have been demonstrated. (the dinner and cocktail meetings of a few are still valid interactions, though they do not have to be conducted in the midst of conferences involving thousands of people and many parallel activities).

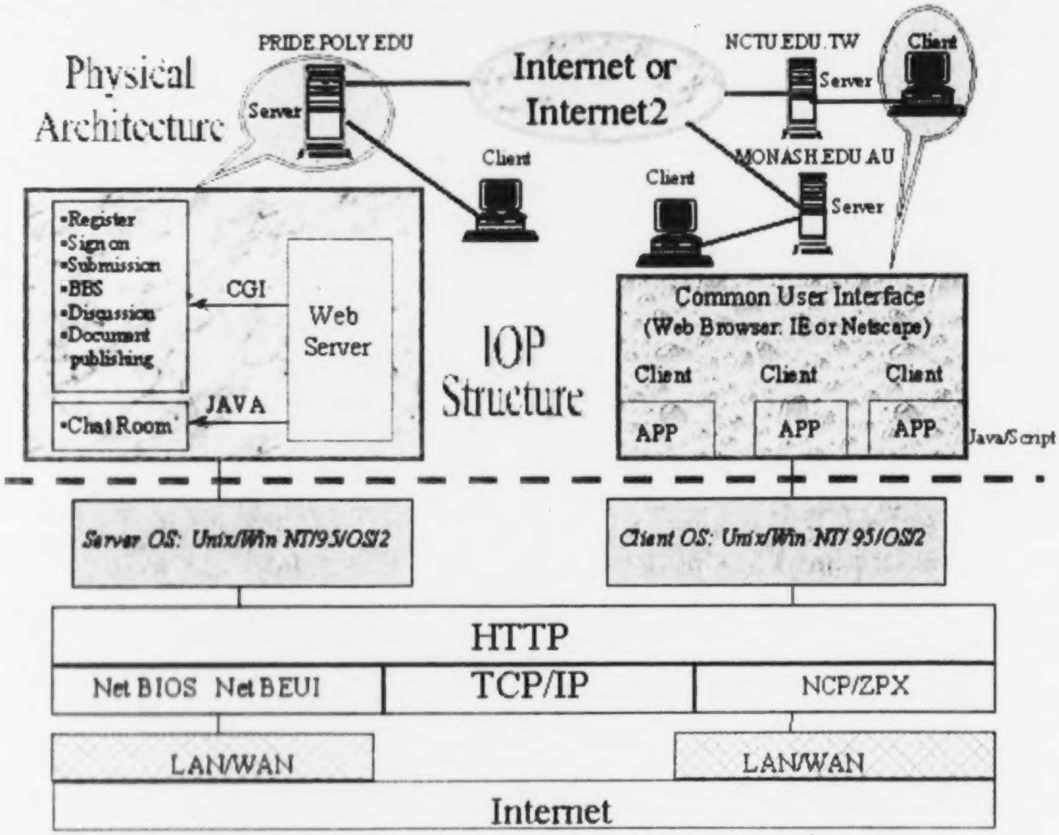
PRIDE.POLY.EDU
Physical Architecture
Server
Internet or Internet2
NCTU.EDU.TW
Server
Client
Client
MONASH.EDU.AU
Client
Server
•Register
•Sign on
•Submission
•BBS
•Discussion
•Document publishing
CGI
Web Server
JAVA
•Chat Room
IOP Structure
Common User Interface
(Web Browser: IE or Netscape)
Client
Client
Client
APP
APP
APP
Java/Script
Server OS: Unix/Win NT/95/OS/2
Client OS: Unix/Win NT/ 95/OS/2
HTTP
Net BIOS Net BEUI
TCP/IP
NCP/ZPX
LAN/WAN
LAN/WAN
Internet

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Fig. 3 Concept and Operation of IRC

The figure above depicts a network infrastructure and a schematic IRC conference system. Concept and Operation of IRC

One can easily extrapolate this diagram to become a sizable conference distributed over many cities having thousands of people attending them in real-time proceedings. Global Information and Software Society (GISS), is a pioneer in the application of IRC since 1995 (16). The movement of IRC (real-time proceedings) is still limited today largely due to a lack of awareness of its intrinsic value and a lack of publicity of its actual working experience.The secondary reason is due to the vested interest of present conference organizations which see the threat of losing a significant business. Yes indeed, the prevalence of IRC will shift the business from airline and hotel industries to the telecommunication and computer industries. With Internet2, many innovative and creative ways of using IRC will be possible. Its prevalence is inevitable and its impact to the telecommunication industry will be very significant as we will illustrate in the next section.

C. Telesurveillance

Strictly speaking, the telesurveillance application is not necessarily just an academic application (e.g., tele-proctoring examination), certainly not from its impact to telecommunication point of view. In 1995,
PRIDE has first created a live camera application on the Web (17). Its intention was more technology-driven than application-driven. The live camera provided weather and traffic information of Route 9A in Hawthorne, and also some surveillance value to PRIDE's premises. In our research on education transformation and in the development of I-CARE, one of the issues surfaced was the need of having Internet Real-Time examinations administered over the Internet. The live camera surveillance concept becomes a possible solution. It is especially cost effective for global collaborative education programs where traveling over long distances for taking exams is cost prohibitive. Fig. 4 depicts the network infrastructure and the video system requirements for telesurveillance.

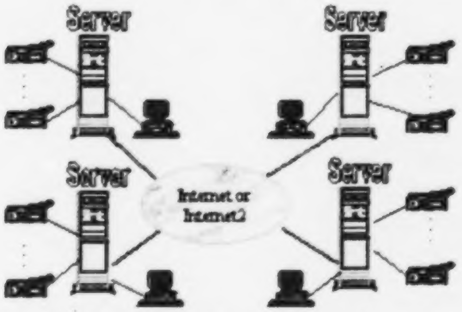


Fig. 4. Telesurveillance via Internet

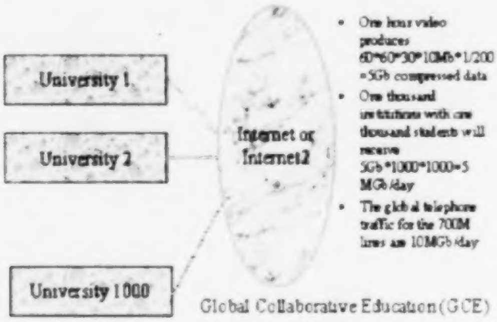
Since the operational procedure of exams and tests are conducted in real-time, a video surveillance scheme is necessary to provide reliable and secure proceedings. However, this application puts large bandwidth demand on the network. It is obvious to extend this application technology to other industrial surveillance, for instance monitoring of hospital operation or manufacturing process in remote locations. If one replaces the exam rooms in Fig. 4 with manufacturing facilities, the system becomes a multi-point group surveillance system with increased redundancy for reliability and security. This kind of surveillance system can also be applied to the monitoring of environmental effects. In such an application, the number of cameras can be a big number and its operation may be 24 hours in real-time. Therefore, the impact of this kind of application to the telecommunication industry can be enormous. As for the academic community, the Internet2 certainly provides an environment for perfecting and implementing the tele-exam application.

IV. The Impact of the Killer Applications to the Telecommunication Industry

We can make a simple analysis from system and network architecture, transmission volume and operational procedure points of view for the above three applications to show their impact to the telecommunication industry.

A. Analysis For GCE Application

Let's first make the assumption, video broadcast will be used in GCE which is a reasonable assumption. Then we assume conservatively, GCE will evolve into a one thousand institutions participation (naturally in groups employing a network architecture similar to Fig. 2) with each institution having one thousand students involved in GCE program each receiving one hour of video education per day in an Internet Interactive Learning mode shown in Fig. 5. We can then state the following:


University 1
University 2
University 1000
Internet or Internet2
One hour video produces 60*60*30*10Mb*1/200 =5Gb compressed data
One thousand institutions with one thousand students will receive 5Gb*1000*1000=5 MGb/day
The global telephone traffic for the 700M lines are 10MGb/day
Global Collaborative Education (GCE)

1. One hour video produces 60x60x30x10 Mbx1/200 = 5Gb compressed data
2. One thousand institutions with one thousand students will receive 5Gbx1000x1000 = 5 MGb/day

Today, the global telephone traffic for the 700M lines are 10 MGb/day. It is clear that the GCE application potentially will put a greater demand on telecommunication network than the total telephony will. In the GCE operation, interaction involving telephony, Web server, e-mail and other communication means will also add further demand on the network, although they are much smaller than the video demand as shown in Table I.

Traffic Volume for 1M Students

E-mail	$1M \times 1K \times 100 = 10^{11}b$/day
Phone	$1M \times 15M = 15 \times 10^{12}b$/day
Web(service)	$1M \times 150M = 15 \times 10^{13}b$/day
Video	$1M \times 5G = 5 \times 10^{15}b$/day

* 100E-mail/day, 1Kb/mail, 15Mb/day per phone line

Table I: Traffic Volume for 1M Students

B. Analysis for IRC Application

Let's assume that IRC will gain popularity to 5000 conferences annually each with 3 days (50 conferences per day assuming 300 working days per year) of proceeding (20 papers each day, 2.4 hours video for keynote and invited speakers). The average present day conference usually has 2000 attendees which may be expanded 10 fold in the IRC global mode. We can then state the following:

1. 2.4 hour video broadcasting produces 2.4 x 5Gb = 12 Gb
2. Five thousand conferences with 20,000 attendees will receive 5000 x 3x 20000 x 12Gb x 1/300 days = 12 MGb/day
3. Five thousand conferences with 20,000 This traffic exceeds today's telephony traffic. Again, there is additional Web serving, chat and e-mail traffic associated with IRC. The Web serving of 20 papers 10Mb each for 1M people per day is also a significant traffic, 2MGb/day.

C. Analysis For Telesurveillance Application

This application is probably more significant if one considers its use in general industry. Let's take Fig. 4 as the architecture for a four-site company surveillance, each site having 10 cameras. We further assume that the surveillance application will grow to one thousand companies. We can state the following:

1. 24 hours surveillance produces 24 x 5Gb = 120 Gb
2. 4 sites mutual coverage of 10 cameras at each site produce 4 x 3 x 10 x 120 Gb = 1.44 x 10 *13b/day
3. For one thousand companies 1000 x 1.44 x 10 *13b/day = 14.4 MGb/day

This traffic volume is greater than the telephone traffic volume today. The operational procedure for surveillance is straight forward, i.e., 24 hours continuous (or at least 16 hours continuous) surveillance. For the academic applications like examinations and tests, one may use the GCE model to arrive at the following analysis.

1. 8 hours surveillance produces 8 x 5Gb = 40Gb compressed data
2. For four institutions to conduct final examination for one thousand students 4 X 1000 X 40 Gb = .16 MGb/day (peak load)

The traffic may be considered as the peak load since exam schedule may be arranged differently. The 0.16 MGb/day is never the less still a significant traffic just for the academic application.

V. Discussions

From the above analysis, it is clear that although telephony may still be a growing business globally in terms of subscribers, but the transmission traffic volume generated by it may not be the dominant one in the future, The traffic generated by the three examples presented here alone potentially can be far greater than the traditional telephony traffic today. Hence, they may be called Killer Applications to signify their importance or potential impact to the telecommunication industry in network capacity and switching or routing equipment. So from network capability planning point of view, these Killer Applications must be taken into serious consideration.

The phone has been the principal tele (remote)-communication means so far, and it is conducted in a synchronous and mostly analog mode. There are other competitive communication means emerging such as FAX (asynchronous analog) and e-mail (asynchronous digital). In telephony, people already experience a number of unpleasant and unproductive phenomenon such as busy line, put on hold, not able to reach the right party, endless phone tag, etc. Whereas, fax and e-mail do not have such problems. It is no surprise that their growth in the telecommunication share have become significant.

The above three applications use principally asynchronous digital communication, although high bandwidth synchronous communication such as video conference may be desired for some occasions. Asynchronous digital communication offers an advantage over synchronous analog communication in data compression and network load balance. The former is derived from a trade-off between transmission cost and processing (coding and decoding) cost. The latter is due to the flexibility of selecting optimal route and transmission time. These characteristics .must be considered by the telecommunication industry in planning its capacity and capability to meet the demand of the twenty first century.

Another concern that may be raised is the impact of Internet telephony (real-time digital communication with modified IP protocols) on the future of telecommunications. It is very natural to incorporate I-phone (combine voice and data over IP) technology in the three application examples discussed above. Use of I-phone brings the application and the users more into a synchronous communication mode. Hence, new protocols (e.g., H.323, T120), routers and Internet telephony gateway products are required. This technology offers the advantages of trading cost between transmission and processing and obtaining the cheapest long distance route, although local phone lines are still used. With the arrival of Internet2, the current problem of voice quality and latency will disappear. The telecommunication industry is fully aware of the emergence of this technology, however, it may not have analyzed I-phone in the context of the Killer Applications cited here. That is, it may not be just a competing telephone product, rather it may accelerate other applications such as Internet Interactive learning or Internet real-time conference into a dominant application. Some of the studies made on Video-on-Demand may be used as a reference (18).

VI. Conclusions

This paper discusses the impact of several critical applications of Internet which may become dominant telecommunication applications with the arrival of Internet2. The momentum of Internet2 is set. The three applications presented here, namely Global

Collaborative Education based on Internet interactive learning and Internet Real-Time Conference and Surveillance show clear potential in dominating or upsetting the telecommunication network capacity depending on whether the telecommunication industry has prepared a right growth strategy or not to meet the demands of these killer applications of the twenty first century. It is hoped that the analysis and discussion presented here will lead to more in-depth studies of these applications and their requirements in network architecture and capacity and various software and hardware communication products.

VII. Acknowledgment

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VIII. References

1. Sean Tappendorf, ARPANET and Beyond, http://clavin.music.uiuc.edu/sean/Internet-history.htlm, July 30, 1995
2. Michael Harben, History of ARPANET, http://www.dei.isep.ipp.pt/docs/arpa.html. Charles Babbage Institute, 25th Anniversary of ARPANET,http://www.cbiumn.edu/darpa/arpanet.htm, Nov. 6, 1996
2. S. Vassallo, History of the Internet, http://bones.wcupa.edu/~svassall/history.htm
3. B.M. Leiner, et al, A Brief History of the Internet, http://www.isoc.org/internet-history
4. Interview With Tim Bernes-Lee http://www.newciv.org/worldtrans/BOV/BI/BI-216.html, May 31, 1995
5. Internet Domain Survey, http://www.nw.com/zone/WWW/report html
6. USA Today, AOL Blackout Could Raise Question Of Reliability, http://www.wst2.USAtoday.com/life/cyber/tech/ct137.htm, Aug. 29, 1997
7. Internet2, http://www.Internet2.edu
8. NCO, Background on Clinton-Gore Next Generation Internet Initiative, http://www.hpcc.gor/ngi/background.html Oct. 10, 1996
9. UI-Online, http://www.online.uillinois.edu/
10. Red Deer College Communication Courses On-Line, http://www.rdc.ab.ca/rdc/comm250/index.htm
11. Ifay F. Chang, Cyberspace Assisted Responsive Education Implemented on the Open Platform - Internet, International Conference on Engineering Education: Progress Through Partnerships, ICEE Proceedings, Vol. 1, pp. 741-748, Aug. 13-15, 1997
12. Ifay F. Chang, An Internet Cyberspace Assisted Responsive Education, PTC97, W.2.1.2, Hawaii, 1997, http://pride-sun.poly.edu/icare
13. Ifay F. Chang, Network-Centric, Group-Centric and Human-Centric Information Processing Systems, 11th International Conference on Information Networking, Proc. I-COIN11, pp10, Jan. 27-29, 1997
14. Ifay F. Chang, Cyberspace Assisted Responsive Education (CARE) - A Solution for Education, http://pride-i2.poly.edu/GISS, pp1-18, GISSIC95 Proceedings
15. Ifay F. Chang, An Internet Realtime Conference: Design, Experience and Future Applications International Office of the Future: Design Options and Solutions Strategies, Edited by Bernard Glasson, Doug Vogel, Peter Bots & Jay Nunamaker, Chapman & Hall, ppg, 81-90, April 9-11, 1996
16. Global Information and Software Society International Conference http://pride-i2.poly.edu/GISS
17. Live Camera, http://pride-i2.poly.edu
18. Ifay F. Chang, PRIDE Report On Video-On-Demand and Multimedia Services, April 17, 1996

Wednesday, January 14, 1997

NOTES:

Telecom in Shanghai: Growth and Development in China's Tiger Metropolis

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Abstract

This paper examines key elements of growth in Shanghai's burgeoning telecommunications industry. It begins with a brief discussion of the city's communication progress over the past decades, then looks at municipal government policies and statistical measures of the industry's recent success. It traces the major contributions foreign companies have made, and the problems they have faced. The paper's conclusion discusses the role the sector will play in the overall development of Shanghai.

Since the late 1980s, Shanghai has re-emerged as China's most dynamic urban center. The development of telecommunications in this city of 17 million has closely followed Shanghai's rapid strides forward. This paper examines key elements of the sector's growth in Shanghai, and spots trends that will shape future progress in the municipality.

The essay begins with a brief discussion of Shanghai's growth over the past decades. It then looks at the evolution of government policy, and turns next to the role of foreign investors. The final section looks at trends that will shape the future of Shanghai's telecom sector.

Growth of Telecom in Shanghai

Shanghai was one of the first cities in China to develop telecommunications services. In 1869, the Cable & Wireless family of companies formed the China Submarine Telegraph Company to lay a 1,700 mile cable between Singapore and Hong Kong via Shanghai. Twelve years later, the Qing dynasty government established the Great Northern Telegraph Company, with 338 subscribers in the municipality, and in 1907 telephone service was introduced. The city was the first in China to introduce long-distance service in 1923.

World War II hampered the industry's growth, but in 1949, when the communists took control, Shanghai had some 85,000 lines installed for about 55,000 subscribers. Though the numbers were small, Shanghai had nearly 30 percent of all telephone lines in the country. The city boasted Asia's largest manual exchange, with a capacity of 6000 lines.

Communist policy emphasized growth in heavy industries, so telecommunications development was slow in the 1950s and 1960s. The central government also feared economic dominance by large urban areas, and re-distributed revenues away from developed cites like Shanghai to inland areas.

Shanghai, then, maintained a five-digit numbering system until it took six digits in 1957, and kept manual switching into the early 1960s. Long distance calls and even communication with suburbs required booking a call in advance with a city operator.

China's Cultural Revolution turmoil of the late 1960s and early 1970s retarded industrial growth across the country, but in 1972 Shanghai was the site of the nation's first satellite earth station. Following the death of radical leader Mao Zedong in 1976, and the rise of Deng Xiaoping two years later, China's new regime put modernization of industry as a top priority.

In the early 1980s, Shanghai city authorities realized domestic equipment could not meet the needs of a growing economy. The first order for DSPC switches came in 1983, and were supplied by Belgium's BTM (now Alcatel) corporation. That same year, the city signed China's first telecom joint venture with the same Belgian company, and formed Shanghai Bell (discussed below) to manufacture switches.

By the end of the decade, economic and political conditions in Shanghai and the rest of the nation inspired accelerated development of the telecom sector. The following section examines key local and national policies that facilitated the rapid growth.

Telecom Policies

Unlike many industries in China that develop at mainly local initiative, telecom is a relatively hierarchical sector, and is shaped by the national Ministry of Posts and Telecommunications (MPT). Its policies were key to many of the advances Shanghai has made in the past decade.

One of the most important central strategies was the "Three 90 Percents" policy of 1988. It stated that 1) 90 percent of central government loans for telecommunications did not have to be repaid; 2) provincial telecom authorities could keep 90 percent of their taxable profits; and 3) the MPT could keep 90 percent of its foreign currency earnings from international traffic. Though the policy was revoked in 1995, revenues directed toward the industry were vital for equipment purchases throughout the nation.

Table 1 below indicates the effect these and other policies had on both Shanghai and national spread of telephones. Note that the effect of the policies were not limited to the large city, as the country as a whole saw similar rapid strides in percentage growth of new subscriptions. The recent slower rates of growth reflect the maturation of the telecommunications system.

Within Shanghai itself, some municipal policies also aided telecom development. In 1985, the city created a special telecommunications leading group, one which included the city mayor, a relevant vice mayor, the Shanghai Post and Telecommunications chief, and other officials to coordinate development efforts. The group helped plan infrastructure installation for telecom development, and worked with the Shanghai price office to set appropriate rates for local calls.

Though the head of the Shanghai P & T was appointed by the MPT, recent leaders Xu Zhichao and his successor, Cheng Xiyuan, seemed to have local support and useful expertise. Xu, for example, had some past experience in market research and economic forecasting.

Table 1: Number of Shanghai Telephone Subscribers, 1985-1997

Year	No. of Subcribers	% increase over previous year	national % increase
1985	186,000	16%	N.A.
1986	210,000	13%	14%
1987	240,000	14%	17%
1988	288,000	20%	24%
1989	361,000	25%	22%
1990	457,000	27%	22%
1991	566,000	24%	25%
1992	768,000	36%	37%
1993	1,080,000	41%	53%
1994	1,580,000	46%	60%
1995	2,230,000	41%	45%
1996	3,030,000	36%	35%
1997	3,600,000 (target)	20%	N.A.

Sources: *Today's Shanghai P &T* [Publication of Shanghai Posts and Telecommunications office, 1994], p. 17; *'97 Shanghai P&T* [Publication of Shanghai Posts and Telecommunications office, 1997], p. 29; *China Statistical Yearbook 1996* (Beijing: China Statistical Publishing House, 1996), p. 531.

Table 2: Telecom Achievements in Shanghai, 1992-1996

	1992	1993	1994	1995	1996
density of main lines*	5.96	8.36	12.22	17.12	23.31
density of telephone sets*	8.97	11.92	16.22	21.33	30.16
density of residence telephones*	9.16	13.6	24.19	35.64	49.68
business revenue (million yuan)	577	946	1,498	2,325	3,349

* Units per 100 people

Source: *'97 Shanghai P&T* [Publication of Shanghai Posts and Telecommunications office, 1997], p. 29.
Note: One yuan is approximately 12 US cents.

Table 2 above summarizes some of the achievements of Shanghai in the past 5 years.

Though local telecom leadership did contribute to the city's achievements, policies set by the MPT set the pace for the sector's growth. In addition to national policy, however, foreign participation and local competition to the previously monopoly P & T office also was an important part of the city's telecom development, as the next section indicates.

Foreign Investment and Local Competition

As noted above, Shanghai hosted the PRC's first telecom equipment making joint venture. The company, Shanghai Bell, was created in 1983, with the current Alcatel holding 30 percent of the venture, the MPT's equipment branch PTIC taking 60 percent, and Belgium's Fund for Development Corporation holding 10 percent. The venture began production of large capacity digital ports in 1985, with fixed assets of 14 million yuan (about $4.5 million).

The choice of the MPT branch as a partner was key to Shanghai Bell's early success, as the company had a market nearly guaranteed by the monopoly carrier. The company had no limit on its production, though other factories in China did have such caps. Production therefore soared in the early 1990s, as table 3 below indicates.

As the table shows, competition in the late 1990s has begun to erode profit margins. Still, the joint venture has reached about 70 percent local Chinese content, and should be able to keep close to its 33 percent national market share of switches into the foreseeable future. Other notable telecom equipment joint ventures in Shanghai include cooperative enterprises with Lucent Technologies, Nortel, and Siemens, the latter located in Shanghai's new industrial district of Pudong where its manufactures include equipment for GSM networks.

On the operations side, China's second carrier, China Unicom, is playing an important role in cellular services, and has spurred the Post and Telecommunications office to lower its prices and improve its service. Shanghai Unicom was established in September 1994 and service was introduced in July 1995. Unlike the three other cities where Unicom launched its first GSM service in that month, namely Beijing, Tianjin, and Guangzhou (Canton), Shanghai was unique in that Unicom managed to steal a march on the local MPT administration. Shanghai Unicom's head start explains in large part its healthier subscriber numbers versus other Unicom branches. Shanghai Unicom signed up an estimated 20,000 subscribers before Shanghai PTA launched its GSM service, while cities such as Tianjin struggled to pass even the 10,000 mark.

Nevertheless, like the rest of Unicom, the Shanghai company faced stiff competition and regulatory roadblocks from the MPT's Shanghai P & T office. The MPT matched and undercut Unicom's GSM mobile handset prices and phone call rates, and made connection to the fixed network a large hurdle. Shanghai Unicom currently charges 40 fen (about 5 US cents) per minute of incoming or outgoing calls, and gives the MPT only about 8 percent of this revenue; but the MPT keeps 92 percent of Unicom's long distance revenue, and 100 percent of international call fees.

Still, Shanghai Unicom claims to have attracted about 40,000 customers by mid-1997, and has 55 base stations. It recently received permission to build a backbone line in the city, and plans to connect an optical cable from southern China and even have its own satellite within two years. It has a cooperative agreement with McCaw to further develop wireless services, though press reports indicate the American side, slow to receive profits from the enterprise, may have a weak commitment to the Chinese company.

Table 3: Shanghai Bell Output

Year	Millions of Ports Sold	Sales Revenue (US$ million)	Revenue per port (US$)
1990	0.45	82	182
1991	0.7	126	180
1992	1.36	222	163
1993	2.84	488	172
1994	4.4	610	139
1995	4.4	546	124
1996	5.8	550	95

Source: *Business China*, Economist Intelligence Unit, September 30, 1996, p. 8.

Unicom has presented the only legal avenue to date for foreign operators to take part in China; foreigners form complicated semi-detached joint ventures with the company, allowing a limited role in managing systems. AT&T, however, seems poised to play a major role in the newly developing Pudong region of the city, and, with pending approval from the central government, may become a key operator for the district's high technology manufacturing and financial centers.

Shanghai's Telecommunications Future

Shanghai has long played a dominant role in China's transportation sector, both internally with its strategic position at the mouth of the Yangtze River, and internationally with the multitude of shipping lines connecting the city's deep water port with multiple ports throughout Asia and the world. This position has contributed to Shanghai's unique characteristics - it is by far mainland China's most cosmopolitan and modern city. As the business of commerce becomes increasingly electronic, Shanghai is seeking to build on its foundations as a major 'entrepot' to become a port of finance and information.

Today Shanghai's stock exchange dominates China's domestic equity capital markets. This position is already reflected in the telecommunications sector by the high proportion of long distance and international traffic in Shanghai vs. other cities. Indeed, some estimates indicate that well over 50% of long-distance and international traffic in the city is related to the city's stock exchange, principally with sister bourse Shenzhen and big brother Hong Kong. The relocation of the city's stock exchange from a colonial era building to a glistening glass tower in the city's new Pudong district is a reflection of the importance the city places on its financial sector.

One question which appears to be a constant in discussions of Shanghai's overall economic future is as follows: How long before Shanghai catches up (or even overtakes) Hong Kong as China's leading trade and financial service clearing house? Answers to the question frequently vary between 5 year and 20 years. However, much of the speculation is posed by those outside Shanghai. The city's inhabitants themselves exhibit a more sophisticated understanding of the situation, recognising that Shanghai and Hong Kong's futures are closely intertwined. As a senior city official recently put it, Shanghai and Hong Kong are like jet engines on a 747. The aircraft needs both to stay aloft.

With continued development of Shanghai, growth in installation of telecommunications equipment and services will continue. Both the central and local governments realize the importance of the latest technology, and have supported policies friendly to the sector's expansion. Foreign equipment makers have enjoyed opportunities for fruitful investment in the city, though foreign operators to date have been nearly shut out of the market. Soon, however, the central government may realize the importance of foreign management know-how for the continued vitality of the "new" Shanghai, and the city will become a magnet for companies playing a role in the progress. The prevailing atmosphere in the city can be seen in the perhaps apocryphal conversation between former British Deputy Prime Minister Heseltine and Shanghai's city leader: "Mr Mayor, I'm told that all the smart people come from Shanghai." "No, Mr Deputy Prime Minister, all the smart people come TO Shanghai."

Telecommunication Regulation In India

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1. *Abstract*

The paper looks critically at the structure and the Role of recently set up Telecommunication Regulatory Authority Of India (TRAI). The Authority needs widening of its role to make it more contemporary and effective for promoting competition in the Telecommunications sector and enable the sector to attract more investments.

2. Introduction

The Government of India passed Telecommunication Regulatory Authority of India Act,1997in the Parliament to constitute a Telecommunication Regulatory Authority of India for the Regulation of Telecommunications Sector. The bill received the assent of President of India on 28th March,1997. The Authority should have been in place in 1992 when the Government of India decided to Privatize the Value added services. The Privatization process for Basic Services having taken off after initial hiccups , the creation of TRAI will certainly hasten this process. However, lot needs to be done to fine tune the TRAI to offer level playing field to the recently introduced Private operators and thus leap frog India into next century.

3. Structure

The Authority consists of a chairman with six members. The Chairperson is a Judge of the Supreme Court of India or a High Court. A member is to have special knowledge and professional experience in Telecommunications, Industry, Finance, accountancy, law, management or consumer affairs. A Government servant can be considered for the post of a member if he has held the post of either a Secretary or an Additional Secretary for a period of three years. He has to retire from the service before seeking such an appointment. The tenure of the post is for Five years subject to an age limit of 65 years. One of the members is appointed as a Vice Chairperson. Disputes are resolved by a bench constituted by Chairperson with two members. An appeal against an order of the TRAI can be challenged in a High court.

4. Functions and Powers

The functions and powers of TRAI are listed under section 11 of the Act and include to Recommend:

The need and timing for introduction of new service provider.

Terms and conditions of license to a service provider.

Ensure technical compatibility and effective interconnection between different service providers.

Regulate arrangement amongst service providers of sharing their revenue.

Ensure compliance of terms and conditions of license.

Recommend revocation of license for non compliance of its terms and conditions.

Lay down and ensure time period for providing local and long distance circuits of telecommunication between different service providers.

Facilitate competition and promote efficiency in the operation of telecommunication services so as to facilitate growth in such services.

Protect the interest of the consumers of telecommunication service

Monitor the quality of service and conduct periodical survey of service provided by the service providers

Maintain Register of Interconnect Agreements and keep it open to any member of public for inspection.

An important power to TRAI includes the fixing of rates for both National and International service

5. Settlement of Disputes:

Settlement of disputes and Adjudication powers between service providers and consumers are exercised by the Regulatory body under section 14 of TRAI Act.

These include:

Technical compatibility and Interconnection between Service providers.

Revenue sharing arrangements

Quality of Telecommunication Services and the interest of consumers.

A bench of two members is constituted by the Chairman for adjudication and in case they disagree, a third member decides the issue. Indian Government by forming the TRAI has moved ahead by an important step towards Privatization of Telecommunication services. However lot needs to be done to fine tune TRAI to make it more effective. Some of the changes required are discussed in the subsequent paras.

6. Indian Telegraph Act

The Indian Telegraph Act (IT Act) was conceived and drafted in 1885. This century old Act needs to be upgraded technology wise and made less hostile and more customer friendly. TRAI Act finds almost half a dozen references to the I T Act. Important powers given to TRAI under chapter III section 11 and chapter IV section 14 of TRAI Act 1997 have been considerably diluted by chapter VI section 25(3) under which "The decision of the central Government whether a question is one of Policy or not shall be final". I T Act under section 5 almost impinges on the personal freedom guaranteed by the constitution of India and gives powers to the Government (nee DOT) to tap or intercept the communications. This provision has mostly been used for political ends. The disputes between the customer and the DOT are to be resolved under section 7 of the Act. The consumer has hardly any say in the dispute. There are other clauses in the I.T. Act e.g. section 10 and 25 which are as dictatorial and anti customer as could have been drafted during the British regime. Several attempts to revise the Indian Telegraph Act have not been successful and it therefore continues to be a stumbling block to the growth of Telecommunications in the country. It is therefore essential to revise this Act quickly, make it customer friendly rather than a strange bed fellow to the TRAI Act 1997.

7. Convergence

The fact that Telephone, Television and Broadcasting Services are getting Integrated allowing new services to be provided over existing Infrastructure demands the Integration of various Acts governing different Industry sectors. It is believed that the impact of convergence on Regulation will be more than the impact of Regulation on convergence. It is therefore necessary that the Indian Government Ministries of Communication, Information, Broadcasting and Department of Electronics are merged into a single Ministry and a single Act drafted to enable Infrastructure to be shared more efficiently The lack of this approach is glaringly visible in the drafting of Cable TV Regulation Act drafted as recently as 1995 which Government may have to repeal. India has 60 million T V sets, 20 million Cable T V Households and only 11 million Telephone lines. A more innovative and Integrated Act could have contributed to the increased Telephone density at a minimal cost and a better Cable T V service to the public than exists today.

In fact the Convergence demands a Single Regulatory body and not an additional Broadcasting Regulatory Authority which is being envisaged. The TRAI membership needs to include Broadcasting interests to offer a single umbrella of Regulation rather than create two separate bodies to Regulate Telecommunications and Broadcasting.

8. Frequency Spectrum

Modern Telecommunication systems are becoming more and more dependent on the use of Frequency Spectrum. Wireless in the local loop together with the inter city and intra city Radio links for the Basic and Cellular services are coming up all over the country. CDMA in the local loop has been accepted by Indian DOT being the most efficient and economical way of solving last mile problem as also for quick deployment. Next few years will see the emergence of LEO, MEO & more GEO satellites for both Mobile and Fixed communications over the Indian subcontinent. This rapid growth of Wireless systems has put extreme demands on the Frequency spectrum which will form the most critical resource in the years to come. Recent auction of spectrum by FCC has proved this point. WPC(wireless Planning & Co-ordination) unit of the DOT will be under tremendous pressure for equitable frequency allotments specially when the Government itself is a Bulk user of the spectrum today which some of it must shed in favour of the private operators. It will be thus difficult to offer a level playing field to the new operators with DOT as the Dominant player controlling the Frequency allotments. WPC therefore needs to be restructured and representatives from Broadcasting and other frequency user departments included in it. The body needs to function independently or attached to TRAI..

9. Restructuring of Department of Telecommunications.

The Government by creating the TRAI has simply complied with the minimum prerequisite for Privatisation process. However one of the important components of any Privatisation package is the separation of the Policy making DOT from the Dominant incumbent operator DOT if the Telecommunication reforms have to succeed and TRAI become effective. The various committee reports generated by the Government from time to time viz Athreya, Gupta, Khan suggesting various models for restructuring have not been implemented as yet. The broad consensus that emerged from these reports was that Ministry of Communications should look after only Policy formulation with a holding company for the various functional & Geographical companies of DOT the operator. However no firm decision about restructuring has been taken as yet.

10. Telecommunication Engineering Center

The main task of Telecommunication Engineering center is to prepare specification Network Engineering, Design and Approvals. The TRAI under Chapter III section 11 of the TRAI Act is authorised to inspect the equipment used in the Network and recommend the type of equipment to be used by the service provider It is also to render advice to the central Government in the matters relating to the development of telecommunication technology and any other matter related to telecommunication Industry in general. It is therefore necessary that the role of framing specifications and Approvals come under the purview of TRAI which will give clarity to the mandate. This will help the induction of new technologies and offer level playing field to the various players competing with each other and is in keeping with the structure of the most of the Regulatory bodies of the developed World. It is realised that the catalytic role of the TRAI for encouraging competition will be diluted unless Telecommunication Research center is reorganised.

11. Universal Service Obligations

The TRAI has an obligation under the Act towards the Universal Service provision by ensuring that all the Service providers install 10% of lines in the Rural areas which forms one of the license conditions. In fact DOT itself has failed in its target to fulfill the obligation of providing connectivity to more than half a million villages by 1997 as laid in the National Telecommunication Policy announced in 1994.

12. Conclusion

The setting up of TRAI through a legislation in the Indian Parliament though an important step in introducing competition in the Basic and Value added services as also for attracting investment, is only the first step. A number of issues have to be settled and the role of TRAI widened to make it effective and contemporary. In addition the structure of TRAI itself needs to be broadened to include expertise and professionals in the areas of Consumer affairs, Economics and Finance etc.

Leveraging Global Resources to be Competitive in Your Own Back Yard

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From Hong Kong to Hanoi, developed and developing nations face growing pressure to liberalize national telecommunications markets in order to compete in an intricately linked electronic global marketplace. By and large, governments around the globe no longer debate the link between modern telecommunications infrastructure and economic development, and are taking measures to prepare for the inevitability of competition in their markets. Many are welcoming the advent of competition, which greatly accelerate the introduction of the new, advanced and lower-cost services required for global commerce.

The trend towards global telecommunications liberalization was formalized this year with the precedent-setting World Trade Organization agreement on telecommunications services. For the first time in history, 69 countries representing some 90% of the world's total telecommunications traffic committed to open their markets to varying amounts of competition, and 54 of them agreed to a set of common regulatory principles intended to create a level playing field for new competitors.

The ability for carriers to enter new foreign, as well as new domestic, markets is creating a growing community of new telecommunications carriers. Where once there were some 200 national administrations, today there are literally thousands of carriers and unregulated service providers addressing various segments of the overall marketplace. Where once being a service provider required owning network facilities or having "facilities-based" status, today providers of all sizes can resell the services of other carriers.

These include local exchange, domestic long-distance and international carriers, domestic cellular and wireless service providers, value-added data and other communications service providers and - perhaps most significant in terms of overall global traffic - a huge range of Internet Service Providers, or ISPs.

Within this changing environment, all carriers/service providers - from the largest incumbents to the smallest new resellers - must be able to quickly adapt to shifting market conditions. This paper will examine how incumbent national carriers, alternative wireless and value-added carriers, ISPs and other service providers within the Pacific Rim can leverage the capacity and interconnection capabilities of intercontinental carriers to quickly obtain competitive advantages in their home markets.

Through examples in Asia Pacific, Europe, the United States and Latin America, we'll explore how incumbent and emerging providers have "borrowed" capabilities of global network providers to package new services branded as their own. From global connectivity, to operator services, to adapting satellite capabilities in innovative applications, it is non-traditional solutions that give local providers the ability to compete on a global scale without having to make world-class infrastructure investments.

A Changing Landscape: The WTO Telecommunications Agreement and its Implementation

Two fundamental elements underpin the regulatory and trade changes which are reshaping the global telecommunications industry: (1) the telecommunications services market opening commitments finalized at the World Trade Organization (WTO) in February 1997; and (2) the measures that individual nations are taking to implement these commitments and market liberalization efforts taken on a unilateral basis.

The WTO Agreement

As is well-known by now, 69 countries, which together represent 90% of the world's telecommunications revenues, have adopted commitments under the auspices of the WTO to open their markets to new telecom competition. These commitments were made in the context of the General Agreement on Trade in Services (GATS) which is the framework within which the 132 WTO member states address liberalization of telecommunications, financial, and professional services markets. The telecommunications elements of the GATS are set forth in a "Fourth Protocol" agreement adopted in February 1997, to which country-specific Schedules of Commitments are appended.

While the commitments vary widely in their quality, scope and schedule for implementation, a number of countries are notable for providing in 1998 meaningful licensing, interconnection and investment opportunities for both domestic- and foreign-owned competitors. For example, the United States, much of the European Union, Japan, Canada, Australia and Mexico have each committed to the establishment of multi-carrier facilities-based and resale competition for local, domestic long-distance, and international voice telecommunications during 1998. Although telecommunications services had already been liberalized to some extent in each of these countries, the WTO negotiating process had the catalytic effect of sharpening the focus on competitive conditions, leveraging further commitments, and forcing a global re-examination of telecommunications policies and priorities. As another example, some 22 countries worldwide have committed to permit competition in the provision of international simple resale (ISR) services in 1998.

Even for the many WTO member countries which declined to enter into a schedule of commitments or whose commitments do not provide for multi-carrier competitive entry, the negotiating process has, hopefully, lead to a greater understanding of the benefits of a competitive marketplace which will lead them to take market opening measures earlier than they otherwise would have.

In addition to the specific commitments, 54 WTO countries agreed to a set of common regulatory principles to provide a transparent and predictable framework for trade and investment in telecommunications services. This is intended to safeguard emerging telecom carriers from the negative effects of unchecked market power by the incumbent PTTs, significantly heightening the new entrants' chances of commercial success. Key elements of these principles are the establishment of an independent regulator and measures to prevent dominant carriers from engaging in anticompetitive conduct; the assurance of transparent interconnection opportunities by new carriers with the networks of incumbent carriers at any technically feasible point; transparent licensing criteria and application thereof; and objective, timely, and transparent allocation of scarce resources (radio spectrum, PSTN numbering plan, etc.).

New National Legislation

The same trends toward liberalization that lead to the WTO telecommunications agreement also have lead to significant new telecommunications legislation in a number of countries, generally intended to reshape the way in which telecom services are offered, to create opportunities for new players in the market, and to substitute private enterprise for government ownership and control. Some notable examples include:

United States of America:

The U.S. Telecommunications Act of 1996 (adopted almost a year before the WTO agreement) was intended to create new opportunities in the world's largest telecommunications market and to lower entry barriers, particularly in the local exchange service sector. Although inhibited somewhat by litigation, the legislation will create significant new players on the long-distance and international scene as the Regional Bell Operating Companies (RBOCs) are permitted to offer in-region long distance and international services. As the price for this entry, the RBOCs must open their monopolies in local markets to competition and must meet a 14-point competitive checklist with respect to licensing and interconnection, among other things. So far, none has met this checklist, but RBOC entry within the next two to three years is highly likely.

Japan:

Japan has adopted legislation to reshape its domestic and international telecommunications industries and has commenced the administrative processes to establish implementing rules by 1998. In connection with this legislation, Japan has divided NTT into separate local and long distance units and permitted KDD, the international operator, into domestic businesses. The legislation also removes all foreign ownership restrictions on new carrier entrants and permits multi-carrier facilities-based and resale competition for all services, without limit on the number of licenses issued.

Canada:

Canada's implementation efforts are on two tracks. First, the government has proposed to amend the Teleglobe Reorganization Act to establish parity between Teleglobe and other Canadian operators in respect of investment by foreign persons and carriers, as well as investment by Canadian-owned carriers, and to establish a licensing regime for carriers and resellers. Additionally, the Canadian Radio-television and Telecommunications Commission (CRTC) has commenced a proceeding to establish a market structure for facilities-based international competition effective in October 1998, when the Teleglobe Canada mandate ends. Also under consideration is the manner in which Canada will apply the maximum use policy intended to promote the use of Canadian facilities for international traffic until December 31, 1999, when the routing policy ends.

Australia:

Australian legislation adopted in 1997 has extended to facilities-based operations the open-entry policies which had for several years been in place for resellers. The legislation ends the duopoly of Telstra and Optus.

Internet Demand Driving Global Telecom Use

As the landscape changes in the way that traditional switched voice services are provisioned, the explosive growth of traffic on the global Internet has itself launched a revolution in the industry. In January 1994, there were just over 2 million Internet host computers worldwide. Earlier this year, there were an estimated 20 million. Industry pundits have even predicted that within the next ten years traffic on the global Internet will overtake traffic on the traditional Public Switched Telephone Network.

Internet growth has been accompanied by a large new base of internet service providers. With over 3,000 ISPs in the United States alone, there are hundreds if not thousands of others in those nations where deregulation has occurred first within the so-called "value-added" services arena.

Within the Asia Pacific region, tremendous Internet demand increases the pressure on the region's carriers to find new and innovative ways to supplement already saturated fiber-optic cable systems. The recently-announced agreement among 14 major telecommunications carriers to jointly finance and construct a new cable system linking China and the U.S. is welcome news to users in the region, tempered only by the two-year wait for the system to be completed.

Global carriers continue to play an important role in extending the economic and educational benefits of the global Internet to a growing community of nations. For many nations, the first connection to the global Internet happens when a country's national telecom administration, teaming with a global carrier, establishes a high-speed link to the United States, where the vast majority of Internet hosts still are located.

For ISPs outside of the United States, the best global backbone services offer competitively priced bandwidth and sophisticated routing to avoid notorious U.S. congestion as much as possible. Additionally, clever alternatives to straight fiber-optic or satellite IP connections are emerging. Let's take a look at an Australian carrier that devised a way to maximize the use of multiple existing facilities to expand its international IP service offering.

Telstra Optimizes IP Bandwidth with Simplex Technology

Internet traffic the world over has always presented a costly dilemma for carriers outside of the United States. Such traffic is typically imbalanced, as a Web user's query or request to view a page is almost always much smaller than the return data stream from the Web site. However, carriers traditionally have had to purchase a two-way, or duplex, submarine cable circuit to connect to the U.S. (where most Internet hosts are located) that has the same bandwidth on both outbound and inbound directions. Many carriers therefore incur unnecessary cost in handling Internet traffic because half their fiber-optic circuit capacity is underutilized.

Satellite links can provide a way around this problem, for they are available on a one-way, or simplex, basis and two such links of different bandwidth can provide an asymmetric duplex channel for Internet traffic. This can offer attractive cost savings to the ISP. However, the half-second round-trip propagation delay via satellite, even with sophisticated router buffering techniques, is often visible to the user and may be objectionable for certain applications.

Australia's Telstra is developing an even more unique solution that uses a high-bandwidth simplex satellite circuit combined with one or more lower-bandwidth duplex submarine cable circuits to provide a hybrid asymmetric link to the United States for Internet access. This arrangement substantially reduces overall transmission costs and effectively leverages the availability of satellite capacity, while cutting in half the delay associated with an all-satellite-based connection.

The service, launched into a trial phase with Teleglobe in a matter of weeks, is believed to be the world's first 45 megabit per second asymmetric satellite/fiber-optic Internet link. Internet inquiries from Australia are sent via existing submarine cable connections to the U.S. Internet backbone. The more data-intensive Internet files routed from the United States are returned back via the simplex satellite link. Not only does this reduce Telstra's costs for Internet traffic, but also since satellite bandwidth can be easily increased, Telstra also can quickly upgrade capacity according to market demand.

Incumbent Carrier Teams with Global Provider for High-Speed IP Link

In the Internet provisioning world, even standard fiber-optic capacity purchases can be done more effectively with a global partner.

In the case of Singapore Telecom, a partnership with Teleglobe announced here in Honolulu at last year's Pacific Telecommunications Conference, enabled the carrier to develop one of Asia's largest internet backbone networks - a 45 Mbit/s link between Singapore and North America. The carriers have since jointly invested in additional bandwidth in Asia-Pacific cable systems to carry Internet traffic from Singapore to the United States. In the United States, Teleglobe provides access to Internet sites for the Singapore traffic.
Singtel, the largest ISP in Singapore, uses the high-speed backbone to provide enhanced internet services to customers in Singapore and region-wide. By choosing a global partner willing to invest in the future of their business, Singtel was able to economically purchase additional capacity and offer broadband-level connections.

Alternative ISP Uses Global Provider to Offer A Market First:

London-based COLT Telecommunications, a major pan-European Internet service provider, earlier this year introduced a Europe-wide first for Internet service provision by linking its own facilities with a commercial transatlantic ATM provider.

COLT launched a new "business class" Internet service, called COLTInternet, that includes a high-speed, 45 Mbit/s transatlantic ATM backbone network which also uses COLT's SDH access network. In addition to the transatlantic ATM backbone, COLT also gained for its customers direct access to the extensive IP and global transit routing of a global carrier. The resulting service is faster and more resilient than competing services.

Competition in Less Liberalized Sectors: Leveraging Operator Services, Calling Cards and Transit Services

In traditional switched voice service markets, where many countries have been slower to liberalize, competition has sprung up nonetheless. New competitors -- including callback services, inbound collect providers using "home country direct" lines, and voice-over-Internet providers -- first target the fastest-growing and highest-margin part of the business: international services. Incumbent carriers need to "sharpen their pencils" and find ways to reduce their costs and their tariff rates for outbound international calling, in order to effectively deal with this challenge.

At the same time, both incumbent and emerging carriers are looking for ways to creatively package existing network services, and to introduce new services and service features, in order to increase market share, stimulate new user demand and improve their margins.

Traditional international services are being looked at in a new light, and new services based on enhanced platforms are being developed. Seemingly mundane features such as directory assistance, operator services, and customized billing are being used in new ways to positively differentiate one provider from the next.

In many cases, the cost and time-to-market for such innovations can be reduced by teaming with a global carrier who has extensive network and platform capabilities in place to support the desired service features. And, importantly, global carriers can significantly reduce delivery costs for IMTS and other international services by providing various types of transit arrangements as an alternative to conventional bilateral interconnections on certain routes. Let us briefly examine a few examples.

Latin American Providers Team with Global Carrier to Build Inbound Collect Base

Incumbent and alternative carriers in Central America, the Caribbean and Mexico have responded quickly to competitive pressures and won back market share from callback operators and from competitively-priced U.S. carriers offering services to expatriates from the region living in the United States.

Inbound (to the U.S.) collect services appeal to Latin American/Caribbean callers in their native countries and in the U.S. because they take advantage of comparatively lower U.S. international calling rates and the often-higher disposable incomes of U.S.-based relatives in a family situation. The service enables them to use a local, toll-free number in the originating country to call relatives in the U.S. and reverse the charges. The called party in the U.S. receives competitive rates, and the charges appear on his or her local telephone bill.

A growing number of carriers in the region are teaming with a global provider, leveraging the global carrier's resources to rapidly implement such competitive collect calling services. Each Latin American/Caribbean carrier markets the service under the carrier's own brand name, and nationally advertises a toll-free number that enables callers to easily connect with the global carrier's Spanish-speaking operators, who complete the call to the United States.

The solution enables these carriers to reclaim market share without having to make any major investments in operator resources, equipment or software.

Calling Cards Provide Access to New Markets

Global calling cards, which caught fire in Europe and Asia in the 1980s and more recently have gained widespread popularity in the United States, offer intriguing possibilities for carriers, retailers and others to offer complementary services and build brand recognition.

Take Ameritech, for example. Traditionally a local service provider in the midwest region of the United States, and one of the regional Bell Operating Companies spun off in the divestiture of AT&T in 1984, Ameritech is aggressively seeking to capitalize on the Telecommunications Act of 1996 to enter the long-distance market.

Prohibited from offering long-distance services within its region until it can meet the FCC'c criteria for a competitive local environment in its own market, Ameritech chose to offer its customers international services via calling cards. When away from home, Ameritech customers can take with them an Ameritech-branded card that gives them toll-free local access from some 60 countries.

The cards not only increase Ameritech's international traffic revenues, but improve its competitive posture on the eve of competition in its local markets. Ameritech local customers using the service can have a trial run of Ameritech, the long-distance provider.

Beyond carriers offering card services, a growing base of enterprising retailers, some uniquely connected to ethnic markets with high international call volumes, are opting to sell global calling cards along with the other services they provide to their ethnic community. From orientation services for recent immigrants to travel service firms, retailers in the larger coastal cities increasingly are offering pre- or post-paid calling cards as a value-added service.

Creative Transit Least-Cost Routing and Transit Arrangements Reduce Carriers' Cost of Delivering International Traffic

Traditionally, international carriers have operated in a "bilateral" world in which each carrier had a bilateral operating agreement with each of its foreign correspondent carriers, and exchanged traffic at mutually agreed accounting rates over mutually agreed direct interconnecting circuits or intermediate transit carriers. Although the majority of all international traffic continues to be exchanged over direct bilateral routes, increasingly both emerging and incumbent carriers worldwide are looking to global carriers for creative transit services that provide global connectivity at the lowest possible costs. Several factors are driving this trend.

First, as growing numbers of new carriers enter the market, it becomes more difficult and less economical to maintain the traditional bilateral interconnection model; the number of pairwise routes needed rises geometrically, and the traffic volume per route may be too low for efficient network utilization.

Global carriers, based in countries with high traffic volumes and possessing extensive route structures and relatively low accounting rates to many destinations, can offer both traditional and non-traditional "switched hubbing" transit services at a fraction of the smaller carrier's cost for direct routes to all these destinations. And, as smaller carriers give some of their traffic to global carriers for routing to third countries, this aggregation of traffic further improves the global carriers' economies of scale and thus the transit prices they can offer. In essence, a "snowball" effect occurs, with the larger global carriers becoming more efficient and bringing down the traffic delivery costs for smaller carriers worldwide.

The growing acceptance of international simple resale, or ISR, as discussed above, will accelerate this trend. For those carriers with enough traffic to establish ISR routes wherever permitted by law, ISR can be a powerful vehicle for driving down their delivery costs. The global carriers will be able to maximize the benefits of ISR, and pass along the savings to their transit carrier customers.

Strength in Numbers

Regardless of the size of the service provider, today's increasingly global telecommunications marketplace requires new strategies and new approaches for delivering services. A new world in telecommunications is dawning, as the WTO agreement and other regulatory developments usher in greater opportunities for new competitors in both domestic and international markets. Emerging carriers can tap global transit partners to extend international calling services for subscribers on their national wireless networks. Incumbent carriers can quickly meet competitive threats and solidify their core consumer calling base by rapidly introducing world-class services and prices without incurring development delays or costs. And both incumbent and emerging carriers can minimize their international traffic delivery costs through creative use of global transit arrangements. In a global marketplace estimated in excess of USD $600 billion, the surest course for providers of all sizes is to gain competitive advantages through wise partnerships, leveraging the resources and experience of a global carrier to offer world-class services.

Advanced Very Low Bit-rate Video Coding Scheme with Synthetic Spatio/Temporal Optimal Information Control

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1. ABSTRACT

A new video coding scheme incorporated with a synthetic spatio/temporal optimal information control is proposed for a high-quality very low bit-rate coding at less than 64 kbps. In the control, the optimal bit allocation is based on the characteristics of each picture critically examined before actual encoding. By using the control scheme, much better picture quality can be obtained than in the conventional ITU standards of H.263.

2. INTORUDUCTION

High-quality very low bit-rate video coding at less than 64kbps, applicable to mobile picture communications or Internet TV broadcasting (Webcasting) on the ISDN or cellular network, is a subject of great interest these days. In this category, ITU-T Recommendation H.263 (1) is well known and its practical hardware as well as software systems are now becoming available. Its picture quality, however, is sometimes too poor for the above mentioned application.

Drawbacks of the present H.263 may be summarized as follows;

- The coding control depends only on a history of previously generated bit amounts disregarding characteristics of the present picture to be coded. As a simple example, in the case of a picture consisting of flat and detailed textures coexisting in the upper and the lower half, too many bits are assigned to the flat region, so that the detail is significantly degraded.
- The picture size to be coded is normally so small such as QCIF that the macroblock size of (16x16) for QCIF is larger than for a standard 4:2:2 picture. This means that coding control even for every macroblock is so rough that degradation of picture quality frequently occurs.
- The interval of the frame is determined after encoding the previous frame. Thus, a minimum frame rate and maximum transmission delay can not be guaranteed. The inconsistency of the frame interval between the transmitter and the receiver becomes on obstacle to real-time communication.

Considering these drawbacks, we made an extensive study on the improvement of H.263, and succeeded in developing a new video coding scheme which is suitable for low bit rates less than 64kbps. The features of the new coding scheme are summarized as follows.

- As pre-processing before encoding, the characteristics of each picture to be coded are critically examined to determine the optimal coding parameters to be assigned for encoding each picture.
- At the same time, objects and backgrounds in moving pictures are effectively separated, and the objects are mainly encoded.
- Optimal encoding is carried out under triangular synthetic coding control between temporality, spatiality and gradation.
- The bit reduction scheme is so-called MC-DCT integrated with an additional new coding scheme mixing Intra and Inter modes and with an optimal quantizer reflecting human visual perception.

By using these key technologies, much better picture quality could be obtained than in the H.263 coding scheme. In this paper, the details of the coding scheme are described and then its coding performance is discussed.

3. DETAILS OF RATE CONTROL

3.1 CONVENTIONAL RATE CONTROL

A basic block diagram of rate control normally used in conventional coding systems including H.263 is shown in Fig. 1. In conventional coding control, a bit stream of quantized data is stored in a real buffer memory in order to smooth generated bit streams so as to obtain a constant output bit rate. The quantization characteristics to be applied for each macro-block are determined by feedback control of the buffer memory occupancy. That is, a higher occupancy leads to rougher quantization characteristics to reduce the generated bit amount. After quantization of the entire frame, the total generated bits determines the number of frames to be skipped in order to complete transmission of the generated bits during a skipped time interval. Thus, the conventional rate control is quite simple and any signal analysis is not implemented in actual encoding.

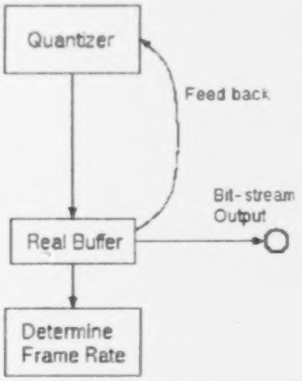

FIGURE 1: SIMPLIFIED BLOCK DIAGRAM OF H.263TMN5 (2)

3.2 SYNTHETIC SPATIO/TEMPORAL CONTROL

The proposed rate control architecture is shown in Fig. 2. The following three factors constitute the synthetic coding control, combined with feedback of buffer memory occupancy.

- Spatial information control
- Temporal information control
- Adaptive quantization control

The most attractive point of the proposed method is its ability to control the optimum operating point adaptively according to frame characteristics analyzed in advance of encoding, and to the status of the output buffer memory obtained just after encoding. With the proposed method, because the frame characteristics are analyzed before encoding, the optimum number of bits can be allocated to every significant area efficiently, whereas with the conventional method the efficiency of bit allocation depends on the distribution of significant areas in the frame. Furthermore, since control of the present frame hardly depends on the results of the previous frame in the proposed method, the encoding control is able to maintain stability even in cases where the scene is drastically altered.

Details of the proposed method, which consists of these three types of controls, are given below.

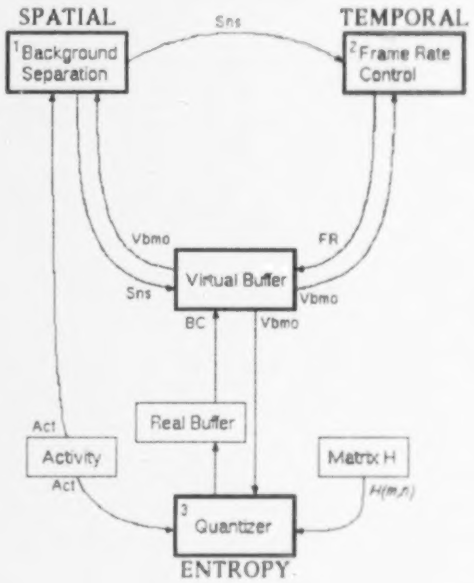

FIGURE 2: BLOCK DIAGRAM OF THE PROPOSED METHOD

3.2.1 SPATIAL INFORMATION CONTROL

Spatial information control means extraction of significant areas in each frame by the separation of object and background with motion compensation. Non-significant areas where motion compensated error is negligible are automatically removed from actual encoding.

The decision of significant/non-significant area is based on the calculation of the absolute difference between the current and the motion compensated macroblock. It should be noted that the motion compensated macroblock belongs to an original picture without coding noise in order to achieve a high accurate motion detection as pre-processing.

The macroblock is actually classified into static, non-significant, or significant, according to the sum of absolute difference values S_{AD}. When S_{AD} is less than a given threshold value T_H, the macroblock is judged as non-significant. When such a non-significant macroblock has a zero motion vector, then the macroblock is judged as static, otherwise it is judged as significant. The classification of macroblocks is shown in Table 1.

TABLE 1: CLASSIFICATION OF MACROBLOCK

Class	ID	Condition	Data
Static	0	$S_{AD} < T_H$, $MV = 0$	(Skipped)
Nonsig.	10	$S_{AD} < T_H$	MV
Significant	11	$S_{AD} \geq T_H$	MV, DCT

The threshold value T_H is determined considering the following:

- Estimated bit amount
- Human visual perception
- Occupancy of output buffer memory

a. ESTIMATION OF THE NUMBER OF BITS

Spatial information control is performed not only for extracting the significant areas but also for estimating the number of bits in the frame to be generated. Therefore, the threshold value T_H is determined to maintain linearity between the number of significant blocks and the number of bits used for the frame. The estimated number of bits in this process is used for temporal information control and buffer memory control. In Fig. 3 we show computer simulation results of the relation between the number of significant blocks (S_{NS}) and the number of bits used for the frame at the threshold value (T_H = 1, 5). It is obvious that the linearity can be attained at the appropriate threshold value T_H.

b. HUMAN VISUAL PERCEPTION

The threshold value is also controlled at every macroblock according to local activity which is closely related to the noise-masking effect (3). For a flat macroblock with small activity, T_H is set to low because a noise-masking effect is hardly expected. On the other hand, T_H is set to high for a busy macroblock in order to suppress unnecessary information which is masked in consideration of human visual perception.

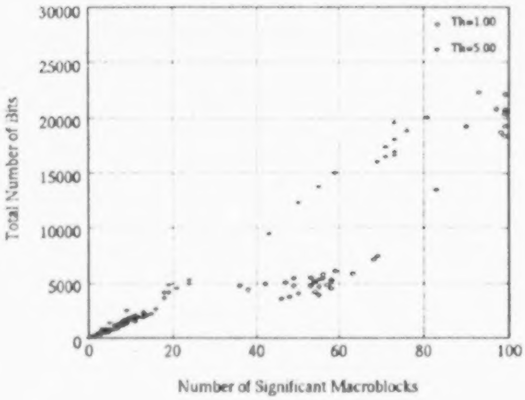

FIGURE 3: RELATIONSHIP BETWEEN S_{NS} AND THE NUMBER OF BITS AT SEVERAL VALUES FOR T_H

c. OCCUPANCY OF OUTPUT BUFFER MEMORY

When the occupancy of the output buffer memory is fairly low, T_H is set to low in order to update the background area, which may not be encoded in the ordinary buffer memory status.

3.2.2 TEMPORAL INFORMATION CONTROL

In the preprocessor, frame-rate is determined for temporal information control. This control is performed according to the number of significant blocks and to the occupancy of the output buffer memory. Consequently, the optimum bit allocation can be realized at a certain usable bit rate.

As described in 3.2.1, the number of significant blocks has a large influence on the number of bits that will be generated for the frame. Therefore, when the frame interval is set proportional to the number of significant blocks, the quantization step size used for encoding is varied only to absorb the difference between the estimated number of bits and the number of bits actually generated, because the bit density allocated to each significant block is the same. The operating point of the quantizer is thus *fixed step size*. On the other hand, when it makes the variation of frame interval small, quantization control tends to depend on the feedback of output buffer memory as with the conventional method, because the number of bits allocated to the frame is almost the same independent of the number of significant blocks. Thus the operating point of the quantizer is *variable step size*. The proposed method therefore has the great advantage that the operating point of the encoder is adaptively varied between *fixed step size* and *variable step size*, by analyzing the frame characteristics in advance of encoding. The relation between the frame interval and the operational point is shown in Fig. 4.

When the occupancy of the output buffer memory is low, the frame interval is set proportional to the number of significant blocks (at left in Fig. 4) in order to keep the quantization step size constant and to give priority to picture quality.

When the buffer memory contains a large number of bits, the frame interval tends to be fixed to the maximum frame skip number. The variation of quantization step size is consequently large, and the quantity of bits generated is suppressed.

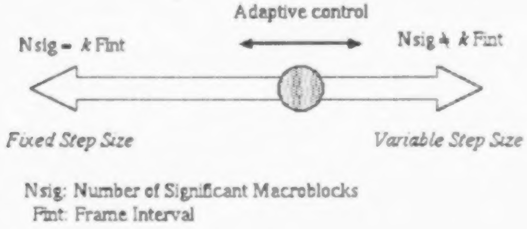

FIGURE 4: ADAPTIVE CONTROL ON THE WORKING POINT

3.2.3 ADAPTIVE QUANTIZATION CONTROL

Adaptive quantization control is performed in the bit-reduction coding. The quantization step size *QP* is determined by taking account of human noise sensitivity to the spatial frequency *H(m, n)*, local activity σ^2 as the noise-masking effect and occupancy of the output buffer memory V_{bmo}. The step size *QP* is given by

$$QP(m,n) = H(m,n)\cdot(aV_{bmo}^2 + bV_{bmo} + c\sigma^2 + dV_{bmo}\sigma^2 + e) \qquad (1)$$

Where *a* through *e* are constants determined by the bit rate, picture size and so on in order to keep the encoder working at the expected point. (3) (4)

3.2.4 BUFFER MEMORY CONTROL

The occupancy of the output buffer memory is reflected in each of the three controls as the number of bits actually generated. With *BS(t)* as the number of bits used until now for the frame, the occupancy of the output buffer memory $V_{bmo}(t)$ is written as:

$$V_{bmo}(t) = V_{bmo}(0) + \frac{BS(t) - FR\cdot\frac{BR}{30}\cdot\frac{n}{S_{NS}}}{F\max\frac{BR}{30}} \qquad (2)$$

where *FR* denotes the frame rate determined in the preprocessor, *BR* the bit rate, *n* the number of significant macroblocks coded so far, and *Fmax* the maximum frame interval.

Since this buffer control method treats a non-significant block as a block that has no information except motion vectors, significant blocks can be coded efficiently without influence from the small number of bits generated for the non-significant blocks and the distribution of significant blocks.

3.3 SYSTEM CONFIGURATION

The configuration of the hardware system actually implemented by the proposed coding scheme is shown in Fig. 5. The encoder consists of a Pre-processor, Bit-reduction coder and Transmitter. In the Pre-processor, motion detection/compensation, local activity detection, significant/non-significant area decision and frame skip number decision are carried out. In the Bit-reduction coder, a motion compensated interframe DCT is employed with a new coding mode consisting of motion compensated interframe coding for lower DCT coefficients and intrafield coding for higher DCT coefficients. This new coding mode is confirmed to give a gain of about

3dB compared to conventional adaptive coding from our actual HDTV hardware codec developed in 1995 (5).

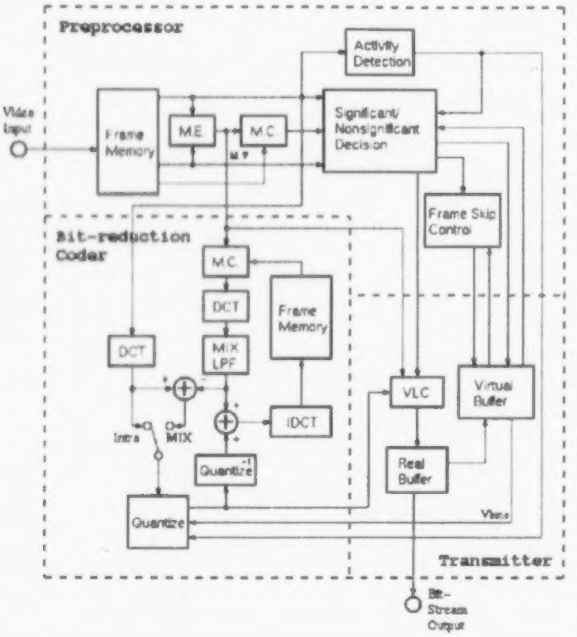
Preprocessor
Video Input
Frame Memory
M.E
M.C
MV
Activity Detection
Significant/ Nonsignificant Decision
Frame Skip Control
Bit-reduction Coder
M.C
DCT
MIX LPF
Frame Memory
DCT
IDCT
Intra
MIX
Quantize⁻¹
Quantize
VLC
Virtual Buffer
Real Buffer
Vbuo
Transmitter
Bit-Stream Output

FIGURE 5: BLOCK DIAGRAM OF THE ENCODER

TABLE 2: WORKING PARAMETERS OF THE CODEC

Format	Y, C_r, C_b
Picture size	QCIF (176x144)
Source frame rate	30 frames/sec.
Spatial control threshold	$1.0 \le T_H \le 32.0$
Frame interval	$2 \le F \text{ int} \le 10$
Motion vector range	[-16, 15.5]
Bit rate for video	BR = 50.878kbps
Buffer capacity	23.7kbits
Transmission bit rate	64kbps

4 SIMULATION RESULTS

Simulation results based on the two methods described below are compared. The first is the proposed method, which has advanced coding controls. The second is based on ITU-T recommendation H.263TMN5 (2).

The conditions of simulation are shown in Table 2. The two pictures used for simulation are "RACE" and "SHEEP". Simulation results coded at 50.878kpbs are shown in Figs. 6 and 7.

As the results show, the PSNR (peak signal-to-noise ratio) is consistently higher with the proposed method.

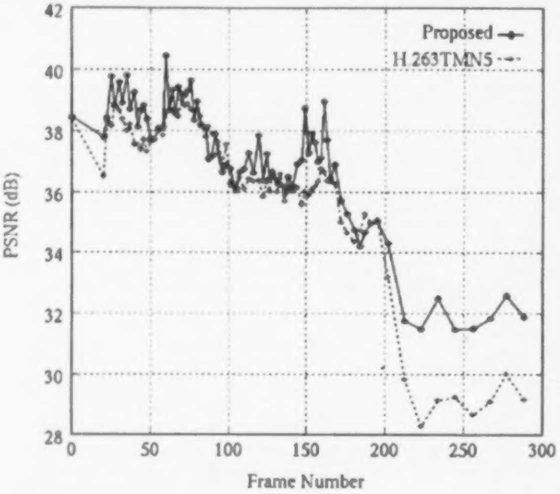

FIGURE 6: PERFORMANCE OF THE PROPOSED METHOD ON "RACE"

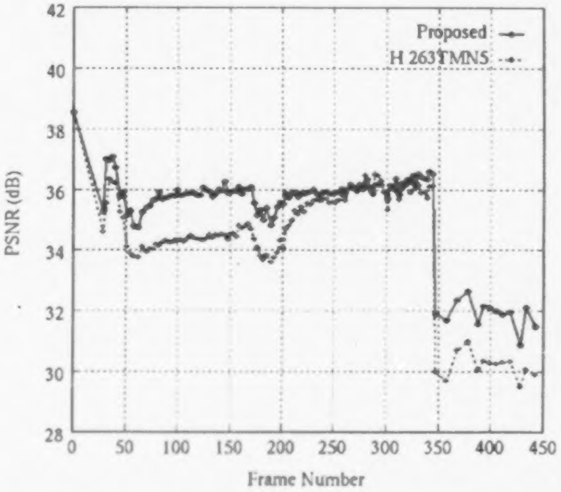

FIGURE 7: PERFORMANCE OF THE PROPOSED METHOD ON "SHEEP"

There are remarkable differences after frame 200 in "RACE" and after frame 350 in "SHEEP". In those scenes, where the camera is tracking a moving object, the number of bits generated for a frame is fairly large. Since the proposed synthetic control by spatial, temporal and adaptive quantization control assigns the optimum number of bits to the significant areas, an improvement in performance can be obtained. Furthermore, the blocking effect is subjectively less noticeable, because the proposed method takes sufficient account of human visual sensitivity.

5 CONCLUSIONS

For very low bit-rate video coding, we proposed a new method that combines spatiotemporal coding control and adaptive quantization control.

In the pre-processing, spatiotemporal coding control is performed in advance of encoding. By this *"prior coding control,"* the significant areas are extracted, and then, the frame interval is determined according to the result of the number of significant blocks. Consequently, the optimum number of bits is allocated to each macroblock as well as each frame. In the bit-reduction coder, adaptive quantization control is performed taking account of human visual sensitivity and the output buffer memory status. Since the operating point of the system can be controlled adaptively by the synthetic control of these factors, picture quality is greatly improved. The hardware system has already been completed for real time encoding and it is now available for real time webcasting.

ACKNOWLEDGEMENTS

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REFERENCES

(1) ITU-T Study Group 15: "ITU-T Recommendation H.263: Video coding for low bit rate communication, " March 1995

(2) ITU-T Study Group 15: "VIDEO CODEC TEST MODEL, TMN5," January 1995

(3) S. Matsumoto, T. Hamada, M. Saito and H. Murakami: "45Mbps Multi-Channel Composite TV Coding System," IEICE Trans. Commun., Vol. **E75-B**, No.5, pp.791-801 (1992).

(4) B. Chitprasert and K. R. Rao: "Human Visual Weighted Progressive Image Transmission," IEEE Trans. Commun., Vol. **COM-38**, No. 7, pp.1040-44 (1990)

(5) S. Matsumoto, T. Hamada, K. Koga and H. Murakami: "Development of high compression HDTV Digital Codec" IEE Telecommunications Conference, No. 404, pp.100-104 (1995)

Interworking Unit Function for Real Time Delivery and Control of Multimedia Service between ATM and Internet

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Abstract

We propose the middleMEN (**middle**men for Multimedia ENvironment) platform for realizing the interworking between the ATM network and the Internet. The middleMEN consists of the interworking unit and the service broker to provide seamless multimedia service between the ATM network and the Internet. This paper proposes the function of the interworking unit of the middleMEN for a real time delivery and control of multimedia service. For a real-time delivery of multimedia service between the ATM network and the Internet, the interworking unit of the middleMEN does the following functions: protocol conversion, and bandwidth adaptation (data format conversion, and bit-rate control). The interworking unit of the middleMEN converts the protocols of the ATM network to the Internet protocols for real-time delivery. Also, it does data format conversion, and bit-rate control to overcome bandwidth difference between the ATM network and the Internet.

1. Introduction

Networked multimedia services are being developed over existing public networks and high-speed communication networks. So various network technologies and services are advanced, information transport capabilities and service control schemes for each network are various. However, the design and engineering activities of all these services, networks, and terminals are currently fragmented across many companies and organizations without any explicit regulatory mechanism that could ensure end-to-end service accessibility.

In the multi-carrier network, seamless integration of terminals and services is essential in order to offer an end-to-end and provider-independent service. The interworking and interoperability become the important requirements for integrating and interconnecting various local and remote multimedia service networks.

ATM technology has been maturing to become a dominant networking technology and the Internet has explosively grown with their easy navigation functionality and the abundance of information sources. In this situation, the interworking between the ATM network and the Internet has an important meaning.

In this paper, we propose the function of the interworking unit between the ATM network and the Internet for a real time delivery and control of multimedia service. In particularly, we describe the differences and interworking requirements between the ATM network and the Internet. And also we present the functions and architecture of the middleMEN and the role of the interworking unit. And then we explain the functions of the interworking unit: protocol conversion, data format conversion, and traffic monitoring and bit-rate control.

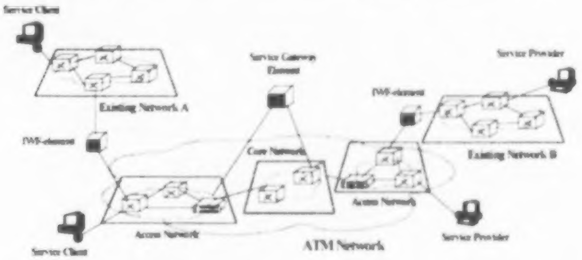
2. Background and motivation

In this section, we show an interworking architecture among heterogeneous networks based on the ATM, and motivate the needs of interworking between the ATM network and the Internet. Also we explain some technical backgrounds of our interworking mechanism.

2.1 Interworking architecture based on the ATM network

As the ATM technology has been maturing to become a dominant networking technology, many studies on the interworking among heterogeneous networks based on the ATM network are done. Figure 1 shows an interworking architecture among heterogeneous networks based on the

ATM. The interworking architecture is consists of an access network that is capable of transporting information over ATM channels, a core network based on ATM transport, different types of clients connected to the access node through the various network, service provider that is directly connected to an ATM network, and interworking elements (IWF-element and service gateway element) (5).



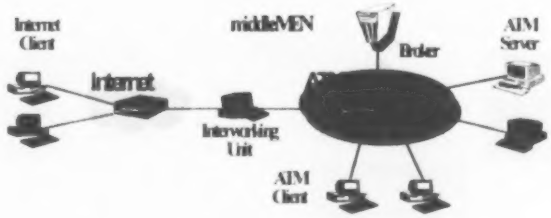
[Fig. 1] Interworking architecture among heterogeneous networks based on the ATM network

2.2 Necessity of interwoking between the ATM and the Internet

ATM technology has been gaining tremendous industry support, and maturing to become a dominant networking technology that will support various services requiring different quality of service. And the Internet (especially the World Wide Web service) has explosively grown with their easy navigation functionality and the abundance of information sources. Recently, the Internet has placed the issue of multi-party multimedia application. Thus the ATM network and the Internet will be dominant networking technology within a few years. It is important to establish interworking scheme between the ATM network and the Internet in order to keep a pace with these changes.

2.3 middleMEN

We propose the middleMEN as a platform for realizing the interworking among the heterogeneous networks. At first, the middleMEN selects the ATM network and the Internet as target network for interworking. The definition of the middleMEN derives from the concept of service gateway and Level 1 gateway. It conforms to the ATM protocol specifications for network aspects, and the DAVIC (Digital Audio-Visual Council) for service aspects. The middleMEN consists of the service broker (service gateway element of figure 1) and the interworking unit (IWF-element of figure 1) as shown in the figure 2 to provide seamless multimedia service between the ATM network and the Internet. In the real, the Internet covers many networks. But, we assumed the Internet as an Ethernet-based network.



[Fig. 2] Architecture of the middleMEN platform

The service broker is located in the core ATM network, and provides easy access to services, offers value-added functions and supports communication capabilities to users in different service domain.

The interworking unit is located between the ATM network and the Internet, and provides functions to overcome the differences of the characteristics of both networks.

2.4 Technical backgrounds

In this section, we explain some technical backgrounds in considering in the middleMEN platform.

2.4.1 DAVIC

The DAVIC is a non-profit association based in Geneva, Switzerland. The purpose of DAVIC (8) is to favor the success of emerging digital audio-visual applications and services, by the timely availability of internationally agreed specifications of open interfaces and protocols that maximize interoperability across countries and applications/services. The current DAVIC 1.0 version of specifications allows the development of systems that support initial applications such as TV distribution, near video on demand, and some basic forms of teleshopping. The general DAVIC system comprises five entities: the content provider system, the service provider system, the service consumer system, and two delivery systems. And, 5 information flows (from S1 to S5) are defined among systems. Figure 3 shows protocol stacks adopted by DAVIC 1.0 specification for information flows.

(a) S1 flow	(b) S2 flow	(c) S3 flow	(d) S4 flow
MPEG2-TS	DSM-CC UU	DSM-CC UN	Q.2931
AAL5	OMG CDR/UNO	TCP/IP	Q.2130
ATM	TCP/IP	AAL5	Q.2110
low layer protocol	AAL5	ATM	AAL5
	ATM	low layer protocol	ATM
	low layer protocol		low layer protocol

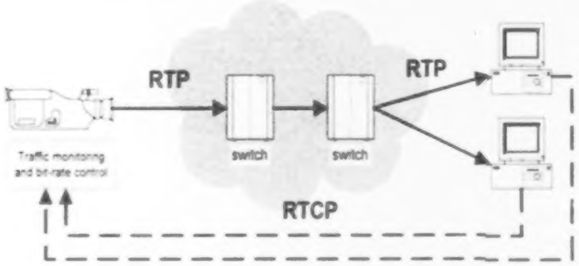
[Fig. 3] Protocol stacks adopted by DAVIC 1.0

2.4.2 DSM-CC

The DSM-CC (Digital Storage Media Command and Control) specification is a set of protocols, which provides the control functions and operations specific to managing MPEG streams (9). However, the concepts and protocols are considered to apply to more general use. A basic principle of DSM-CC is that there is a finite supply of the resources needed to provide services and these resources need to be managed. DSM-CC defines a logical entity called the Session and Resource Manager (SRM) which provides a centralized management of the DSM-CC sessions and resources.

2.4.3 RTP and RTCP

RTP (Real-time Transport Protocol) (3) is application-level protocol that is designed to satisfy the needs of multi-party multimedia application. The protocol consists of two parts: the data transfer protocol RTP and the control protocol RTCP. The RTCP provides mechanisms for data distribution monitoring, cross media synchronization, and sender identification. This control information is disseminated by periodically transmitting control packets to all participants in the session. The primary function of the RTCP is to provide feedback to the session on the quality of the data distribution. This information is critical in diagnosing failure and monitoring performance, and can be used by applications to dynamically adapt to network congestion. Figure 4 shows the distribution monitoring mechanism using RTP and RTCP.



[Fig. 4] Distribution monitoring

2.4.4 RTSP

The application-level RTSP (Real Time Streaming Protocol) aims to provide a robust protocol for streaming multimedia in one-to-many applications ver unicast and multicast, and to support interoperability among clients and servers from different vendors. RTSP is considered more of a framework than a protocol. It is intended to control multiple data delivery sessions, provide a means for choosing delivery channels such as UDP, TCP, IP Multicast, and delivery mechanisms based on RTP. Control mechanisms such as session establishment and licensing issues are being addresses.

3. Functions of the interworking unit

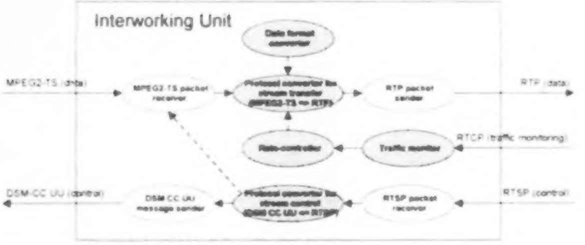
The interworking unit of the middleMEN is located between the ATM network and the Internet, and provides functions to overcome the differences between the ATM network and the Internet.

To extract the interworking functions between the ATM network and the Internet, we describe the differences of the ATM network and the Internet.

- Protocol difference: The ATM network and the Internet use different protocol for real-time multimedia service. Thus the interworking unit converts protocol between the ATM network and the Internet.
- Bandwidth difference: Even though the ATM network can provides sufficient bandwidth for real-time multimedia service, the Internet can provides smaller bandwidth than the ATM network usually. Thus the interworking unit must overcomes bandwidth difference between two-telecommunication network. Moreover, the ATM network basically guarantees QoS (Quality of Service). But the Internet is best-effort network, thus dose not guarantees QoS. Thus the interworking unit must overcomes difference of QoS guarantee.

As previously mentioned, we must overcome the difference of protocol and bandwidth for the real-time transfer of multimedia service between the ATM network and the Internet. Thus the interworking unit of the middleMEN does protocol conversion and bandwidth adaptation function. The interworking unit converts protocols of the ATM network and the Internet to overcome protocol difference between the ATM network and the Internet. And, We propose two methods to adapt bandwidth difference between the ATM network and the Internet – data format conversion, and bit-rate control. Data format conversion method overcomes the bandwidth difference by converting data format. And bit-rate control method adjusts data amounts by traffic status in the Internet.

Figure 5 depicts the functions of the interworking unit and the their relationships.


Interworking Unit
Data format converter
MPEG2-TS (data)
MPEG2-TS packet receiver
Protocol converter for stream transfer (MPEG2-TS => RTP)
RTP packet sender
RTP (data)
Rate controller
Traffic monitor
RTCP (traffic monitoring)
DSM-CC UU (control)
DSM CC UU message sender
Protocol converter for stream control (DSM CC UU => RTSP)
RTSP packet receiver
RTSP (control)

[Fig. 5] The functions and their relationships of the interworking unit

4. Protocol Conversion

In this section, we introduce the protocols of the ATM network and the Internet on stream control, session control and stream transfer for providing real-time multimedia service. And we explain protocol conversion method of the interworking unit of the middleMEN.

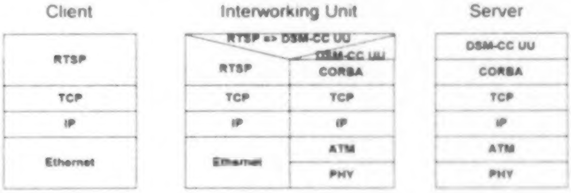
4.1 Stream and session control

We deployed DSM-CC protocols to control real-time multimedia services on our heterogeneous network environments. In DSM-CC model, the users of DSM-CC network are the server and the client. But our network model is more complex. A MPEG stream is stored in the server of the ATM network and delivered to the client of the Internet through the interworking unit. Furthermore, RTSP is used to control real-time multimedia stream in the Internet. In our DSM-CC model, User-to-User (U-U) and User-to-Network (U-N) entity including session manager in the interworking unit serves as DSM-CC U-U and U-N Client entity for managing DSM-CC signaling within the ATM network. And the session manager in the interworking unit manages the internet-to-ATM network communication sessions additionally. It is responsible for establishing and terminating connections cooperating applications for providing requested multimedia services.

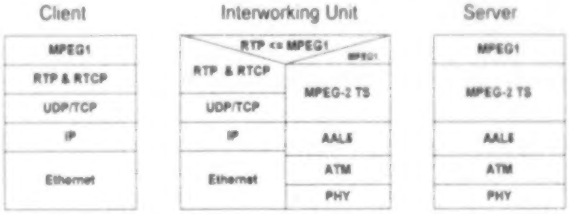
The U-U entity in the interworking unit converts RTSP to DSM-CC UU protocol to control multimedia stream of the ATM network to the Internet user. Figure 6 shows the protocol conversion stack for the control of real-time multimedia stream.

4.2 Stream Transfer

MPEG-2 TS (Moving Pictures Experts Group-2 Transport Stream) over AAL5 (ATM Adaptation Layer 5) is used to transfer real-time multimedia stream in DAVIC specification. Also, RTP over UDP/IP is used to transfer real-time multimedia stream in the Internet. Thus the interworking unit of the middleMEN converts MPEG-2 TS over AAL5 protocol to RTP over UDP/IP protocol to transfer multimedia stream of the ATM network to the Internet user. Figure 7 shows the protocol conversion stack for the transfer of real-time multimedia stream.


Client
Interworking Unit
Server
RTSP
TCP
IP
Ethernet
RTSP => DSM-CC UU
DSM-CC UU
RTSP
CORBA
TCP
TCP
IP
IP
ATM
PHY
Ethernet
DSM-CC UU
CORBA
TCP
IP
ATM
PHY

[Fig. 6] Protocol conversion stack for stream control


Client
Interworking Unit
Server
MPEG1
RTP & RTCP
UDP/TCP
IP
Ethernet
RTP <= MPEG1
MPEG1
RTP & RTCP
MPEG-2 TS
UDP/TCP
IP
AAL5
ATM
PHY
Ethernet
MPEG1
MPEG-2 TS
AAL5
ATM
PHY

[Fig. 7] Protocol conversion stack for stream transfer

5. Bandwidth adaptation

In this section, we explain the necessity and methods of the bandwidth adaptation.

5.1 Data Format Conversion

Usually MPEG2-level video data are used multimedia service such as VOD (Video on Demand) service in the ATM network. MPEG2 data needs bandwidth of 3-10M. It is usually impossible to transfer MPEG2 data in the Internet because of low bandwidth. The data format conversion methods (2) provides a mechanism for matching the transmission quality to the heterogeneous bandwidth constraints. Thus the interworking unit of the middleMEN is good point to apply data format conversion to adapt the bandwidth difference between the ATM network and the Internet.

Researches on the media conversion (ex. MPEG1-to-MPEG2, MPEG2-to-MEPG1, etc) are doing actively. But that field is not stable state yet and we don't have media conversion technology. We apply following data format conversion method in the interworking unit of the middleMEN. Server stores MPEG1 data as MPEG2-TS format. As a request of the Internet user, MPEG1 data having MPEG2-TS format are delivered to interworking unit of the middleMEN. Then the interworking unit converts MPEG1 data having MPEG2-TS format to MPEG1 data having MPEG1-PS format. MPEG1 data having MPEG1-PS format will be delivered to the Internet user.

5.2 Bit-rate control

We cannot overcome the difference of bandwidth as only the data format conversion method. The reason is that because the Internet is best-effort network and dose not guarantees QoS, real-time multimedia service is effected by the traffic of the Internet. By increasing the traffic, frequently service data can not be delivered correctly and timely. Real-time multimedia data is useless if those does not delivered timely. We also propose the bit-rate control method to overcome the bandwidth difference. If the traffic of the Internet is increasing, it is better that the sender of multimedia data reduces the amounts of multimedia data. How to know that the traffic of the Internet is increased? And in that situation, what is best method to transfer real-time multimedia data?

We can know the traffic status of the Internet by using RTP. As shown the figure 4, the sender transfers multimedia data by using RTP packets. Then the receiver periodically sends RTCP RR (Receive Report) packets that have information about the receiving RTP packets. Thus the sender can know the traffic status of the Internet.

If the traffic of the Internet is increasing, then the lost packets and untimely packets will be increased. Bit-rate control (1,4) adjusts the bit-rate of data by the traffic of the Internet. Thus we can minimize the degradation of communication quality.

The bit-rate control mechanism of MPEG1 video is like this. MPEG video consists of I-pictures, P-pictures, and B-pictures. In normal state, all pictures are delivered to the Internet clients. When the traffic of the Internet is increasing, we transfer only I-pictures and P-pictures. Then we can down nearly 30% of traffic. If we transfer only I-pictures, then we can cut down more than 50% of traffic. Even though the client can not receive the all pictures, the client can see more good quality of video in the real.

6. Conclusion

In this paper, we present the function of the interworking unit of the middleMEN for a real time delivery and control of multimedia. The interworking unit has functions of protocol conversion, and bandwidth adaptation (data format conversion and bit-rate control) between the ATM network and the Internet. Those methods will be used to provide seamless multimedia service among the heterogeneous networks in the situation of different protocol and bandwidth.

Even though the middleMEN provides the interworking between the ATM network and the Internet in the short term, the middleMEN will provides framework for the interworking among the heterogeneous networks in the long term.

References

[1] S., Park, et al, "A New MPEG-2 Rate Control Scheme Using Scene Change Detection," ETRI Journal, Vol. 18, No. 2, July 1996.

[2] Elan Amir, Steven McCanne, "An Application Level Video Gateway," In Proc. ACM Multimedia '95, San francisco, CA, Nov. 1995.

[3] Schulzrinne, H., Casner, S., Frederick, R., and Jacobson, V. "RTP : A transport Protocol for Real-time Applications," Internet Engineering Task Force, Audio-Video Trasport Working Group, Mar. 1995.

[4] Busse, I., Deffner, B., Schulzrinne, H., "Dynamic QoS control of multimedia applications based on RTP," Computer Communications, Vol. 19, pp49-58, 1996.

[5] S. W. Sohn, J. S. Jang, C. S. Oh, "Architecture of Multimedia Service Interworking for Heterogeneous Multi-Carrier ATM Network," In Proc. IS&N '97, Cernobbio, Italy, May. 1997.

[6] D. Hutchison, R. El-Marakby, L. Mathy, "A Critique of Modern Internet Protocols: The Issue of Support for Multimedia," In Proc. ECMAST '97, Milan, Italy, May. 1997.

[7] R. El-Marakby, D. Hutchison, "Delivery of real-time continuous media over the internet," In Proc. ISCC '97, Egypt, June 1997.

[8] Digital Audio-Visual Council, DAVIC 1.0 Specifications, Berlin, Dec. 1995.

[9] ISO/IEC International Standard 13818-6 - MPEG-2 Digital Storage Media Command & Control, July 12, 1996.

ExSight - Multimedia Information Retrieval System

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ABSTRACT

This paper proposes a database centric approach to facilitate flexible image retrieval based on the indexing of component subimages (or simply objects) and impression words. The required techniques we proposed for the approach are described. Key points in this approach are (1) automatic image data analysis, especially automatic object extraction, on natural photographs (2) multiple reference object retrieval and (3) high performance data access mechanisms. As a prototype system which embodies these ideas, ExSight is presented with a simple evaluation result using this system.

1. Introduction

Recent advances in digital media technology have resulted in a rapidly growing demand for fast and convenient access to very large amounts of stored multimedia information. Therefore, it is necessary to develop a variety of large scale database systems for the storage, manipulation and presentation of multimedia data. Among such systems, image database systems have proved the most promising. Key requirements for the image data retrieval methods of these systems are speed, accuracy and flexibility. In particular, content-based similarity retrieval has been addressed as one of the most promising solutions for such systems [Flickner 95][Gupta 97].

This paper describes a database centric approach to image retrieval that is based on the application of content-based retrieval to the component subimages of an image. *ExSight*, our image retrieval prototype system currently under development, allows for flexible image retrieval by providing high speed indices for the subimage data and an intelligent query mechanism.

In Section 2, we describe the basic principle behind our database centric approach with a brief analysis of the related work. Section 3 details component techniques we invented and/or adopted in order to achieve our image retrieval approach. The implementation of *ExSight* is presented in Section 4 and Section 5 contains a preliminary evaluation of the system. Section 6 suggests possible applications where *ExSight* can be used and concludes the paper.

2. Our approach to image retrieval and related work

Broadly speaking there are two types of image search; keyword retrieval and similarity retrieval. Keyword retrieval relies on the mostly human input of textual annotations which can be stored in a database together with the images. In similarity retrieval, which in most cases refers to content-based retrieval, images are represented by a set of feature vectors. A search is performed by comparing the feature vectors of the reference and target images to find the most similar.

2.1 Object-based retrieval

As mentioned in [Gupta 97] , in the case of image data, one of the most important types of content-based similarity retrieval makes use of the component subimages, or more simply objects, within the image.

One typical approach to object-based retrieval is 'on the fly' template matching [Vinod 96], where each image in the database is scanned repetitively in an attempt to find a matching part to the reference. However, such methods face a significant time performance problem when applied to very large databases.

Our approach, on the other hand, is a database-centric approach, which includes a data preprocessing phase similar to the case of keyword retrieval. Object extraction and the calculation of associated feature vectors are carried out in advance and the information obtained is stored in the database. This information is later used in query processing.

Normally, object identification is extremely human labor intensive in the same manner as assigning keywords to each image. The cost of this labor is prohibitive where the database contains hundreds of thousands of images. Although some research projects have attempted to solve this problem [Ashley 95], all proposed methods still require some human interaction, or can only be applied to simple images such as an image containing a single object against a monotone background.

An essential part of our approach is to be able to carry out the necessary preprocessing completely automatically, saving significant human effort. The main difficulty for automatic object extraction has been that object recognition

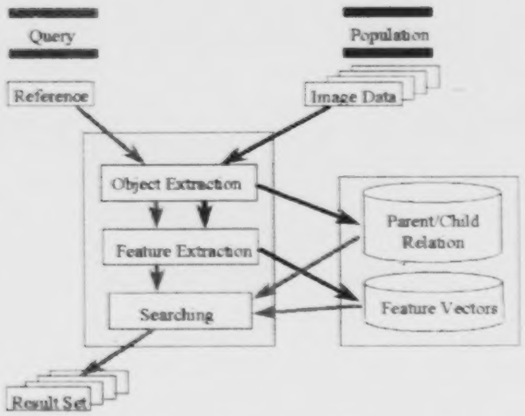

Figure 1: Object-based Retrieval Process Flow

was not sufficiently advanced to be able to extract meaningful objects from complex images such as everyday photographs. The first major element of our approach to object-base retrieval is to extract as many object segments as possible from an image, including all potential meaningful objects as well as many meaningless redundant objects. All extracted objects are stored in the database. The second element is the use of a multiple reference query. For example, although the object extraction may fail to extract a man in bluish clothes, if both bluish clothes and a human face are extracted as separate objects, we can retrieve the man in bluish clothes by the combination of similar searches with bluish clothes as the first reference and with a human face as the second reference. Figure 1 shows object-based retrieval process flow in our database-centric approach.

2.2 Impression-based retrieval

Impression-based retrieval is another type of content-based similarity retrieval. Such retrievals make use of a dictionary of mappings from impression words (e.g. elegant, happy) to typical color patterns. Three or five prominent colors are extracted from an image in the form of a feature vector during the preprocessing phase and stored in the database. The retrieval is performed as a similarity search between this feature vector and corresponding color patterns for the impression words chosen by the user. Again, the preprocessing and storage of image data is vital to the success of the retrieval.

2.3 High performance data access for similarity retrieval

Content-based similarity retrieval is based on the comparison between feature vectors extracted during the preprocessing phase and feature vectors extracted from the query reference specified by a user. More specifically, it is performed by looking for the k-nearest neighbors of the reference, based on a similarity distance defined in the high dimensional feature vector space. Manhattan distance or Euclidean distance is usually used for the distance measure. Importantly, even if the number of images in the database is small, the number of component objects with which we really need to compare the reference is large; a single image can be composed of hundreds of objects. Therefore a linear search of the vectors does not provide adequate performance and more efficient data access techniques are required to make our approach to image retrieval feasible. Several high dimensional indexing techniques have been studied [White 96]. We achieved high performance data access for the similarity search by modifying such existing techniques or inventing new indexing mechanisms, including a parallel processing mechanism.

2.4 Combination retrieval including keyword retrieval

When data for such image attributes as title, date, and author are available, keyword retrieval is, of course, a powerful way to find images. Practically, combination of similarity retrieval and keyword retrieval is important [Ogle 95]. *ExSight* supports the inclusion of keyword retrieval. Users can give the system a query such as "Show me some elegant pictures by Adams which have a red apple around here like this reference."

3. Component functions and techniques

3.1 Automatic analysis of image data

3.1.1 Object extraction

To extract objects from the raw image input data, we propose a heuristic method for the segmentation and merging of regions within the image. The outline of the method is as follows:

(Step 1) Calculate the edge magnitude (256 levels) of each pixel in the input image.

(Step 2) Choose level one of the edge magnitudes as a threshold and identify regions with an edge magnitude less than this threshold as initial segments.

(Step 3) Increase the threshold level (relaxing the boundary) one by one merging segments. Take each of the segments that are merged into one segment as an object. Figure 2 shows the process of the method.

Since the method takes each set of adjacent segments as an object if they are merged in the process of boundary relaxation, a lot of overlapping redundant objects are extracted. These redundant objects may be useful to increase the possibility of matching a query reference, but many meaningless objects are included as well. In order

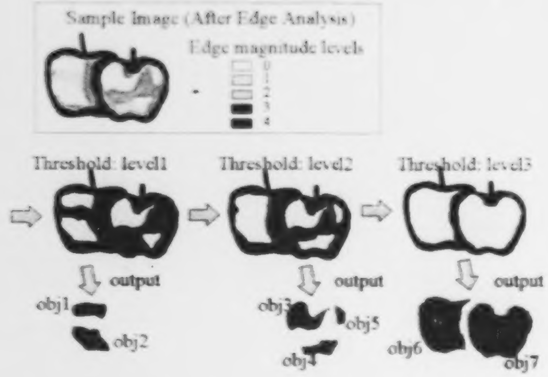

Figure 2: Segmentation and Merge Method from Edge Magnitude Threshold

to reduce the number of redundant objects, very small objects (e.g. less than 100 pixels in size) are ignored.

We also invented a method for excluding overlapping redundant objects so as to take only one representative object for one particular spot within an image. For this cut-off method, we have proposed an Object-Extraction tree(OE-tree) to keep track of the extracted objects throughout the segmentation and merge process. Applying the following cut-off rules on the OE-tree, results in objects, other than the representative one, being discarded from the tree.

(Rule 1) Do not take the whole image itself as an object.

(Rule 2) Do not take a segment as an object if it shares a bounding rectangle with the merged segment.

As shown in Figure 3, this method is able to extract distinct objects from an image with homogeneous color objects (right), where a conventional color clustering segmentation method failed (left).

3.1.2 Feature vector extraction

We make use of the following feature vectors to represent an object.

- color histograms for hue, saturation, intensity, red, green, and blue planes

16 or 32-dimensional color histograms for each feature

- outershape

The most common method for shape representation is a combination of heuristic shape features (circularity, eccentricity, major axis orientation) and a set of algebraic moment invariants which together make up a 10 to 20 dimensional shape vector. As an alternative we propose a new method for representing objectshape called outershape. The outershape feature is a vector derived from the graph of the distance between the object's circumcircle and the outer edge of the object as it varies over the 360 degrees of the circle. Start point normalization is included to ensure rotation free matching can be achieved.

- area size

The number of pixels in the object

- position in the parent image

The normalized two-dimensional (x, y) coordinates of the position of the object centroid in its parent image.

In addition to the above features, we extract 3 or 5 prominent colors as a feature vector for each parent image for use in impression-based retrieval as described in 2.2.

All of these feature vectors are obtained automatically during the image data analysis preprocessing phase.

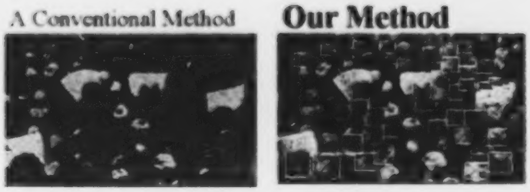

Figure 3: Sample Result of Object Extraction

3.2 Data model and retrieval

The main entity types in our data model are image (parent) and object (child) The model includes links to represent the relation between each image and its children objects. An object's attributes includes a set of feature vectors. An image's attributes include title and author (to be used in keyword retrieval), as well as the impression feature vector described in 3.2.

The first step in object-based similarity retrieval, is to obtain a set of similar objects for a given reference. This result set is found in terms of overall similarity. The overall similarity of an object is determined as a function of its similarity distance on each feature. Typically this function is a linear combination of the individual feature distances with each distance assigned a weight to reflect its importance in the overall distance calculation. Therefore tuning the set of weights (or so called weight vector) is important in order to adequately reflect the query intention of a user. Since it is very difficult for a general user to specify his or her intention using the weight vector, interactive adjustment of the weights will be required. The algorithm for this function is still under development. In the second step of the retrieval, parent images are identified by tracing the links from the child object to its parent image.

In the case of multiple reference object retrieval, the result sets containing parent images for each individual reference are merged into one final result set. In this case, a weight vector can be chosen for each reference. As an example of multiple reference retrieval, figure 4 shows a search for 'a-man-in-bluish-clothes'.

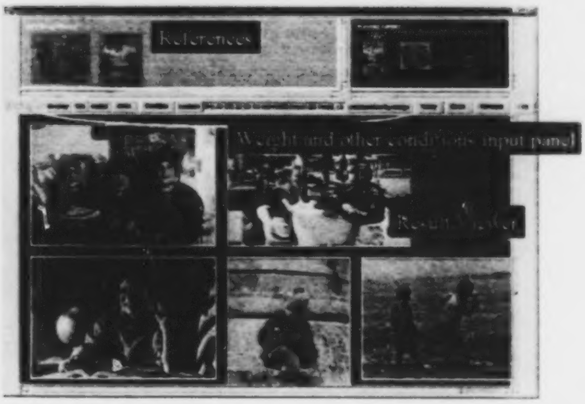

Figure 4: Multiple Reference Object Retrieval

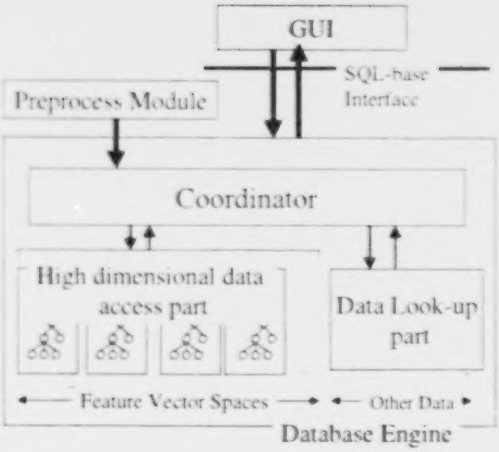

Figure 5: *ExSight* System Overview

3.3 High performance data access techniques

As mentioned in 2.3, high performance data access methods for high dimensional feature vector spaces are critical to our image retrieval approach. We have focused on two different types of high dimensional index:

(1) Tree type index - R-tree and C-tree

The R-tree is an extension of the well-known B-tree indexing method to multidimensional space. Among the many R-tree variants, the VAMSplit R-tree [White 96] appears to be one of the most successful implementations. Once an index tree has been constructed, a fast search algorithm to find the k-nearest neighbors is most important. In most cases, tree index searches use the minimum bounding hyper-rectangles (MBR) stored in the tree structure to efficiently locate the nearest neighbors. Therefore the size and shape of the MBRs are a dominant factor in performance. We developed a new tree index named C-tree which is constructed using a non-hierarchical clustering method. The new tree aims to make MBRs closer to a hypersphere to increase performance. In some cases, the C-tree can outperform the VAMSplit R-tree by 10 to 20 percent, but further investigation and evaluation are needed.

(2) File type index - MIAS

The Multiple Inverted Array Structure(MIAS) is a data structure which has one inverted array for each dimension of the feature vector. The advantage of this data structure is that it is completely independent of any kind of similarity measure. Thus we can select an appropriate measure for each feature space. Moreover since each inverted array can be handled independently, it is suitable for parallel processing.

To achieve the flexible retrieval described in 3.2, we take advantage of a coordination function to combine several search results into a coherent single set of results ranked by overall similarity of the linear weighted combination of similarity distances. The result set returned by each individual feature space will be different and the ranking of objects in the individual space is not the same as its ranking of overall similarity. It is obvious that simply retrieving and combining the top k ranked objects from individual spaces to obtain the top k of overall similarity is not enough. Let k' be a number of results to be returned from a feature space to obtain the final top k. We want to choose k' such that it is larger than k, but as small as possible to achieve better performance. We addressed this problem, illustrated by experiment, in [Curtis 97]. The coordination function also deals with the optimization of queries that combine similarity and keyword searches.

ExSight includes a data access engine which takes advantage of these high performance data access mechanisms.

4. Prototype implementation

Following the process flow of figure 1, we designed and implemented the image retrieval prototype system named *ExSight*. Figure 5 shows the system overview. *ExSight* has a client / server architecture. The main components are Preprocessing module, Database engine which are in server part and GUI module in client part.

4.1 GUI module

GUI module consists of query composition part and viewer of the results. Users can specify their query by preparing reference object and typing in keywords. This client part is implemented in Java for the use of WWW environment.

4.2 Preprocessing module

The Preprocessing module is responsible for the automatic analysis of raw image data consisting of object extraction and feature vector extraction described in 3.1.

4.3 Database engine

The Database engine embodies the techniques described in 3.4. It consists of three basic components. First, a set of high dimensional data indices that can be used to achieve high performance searching in high dimensional feature vector spaces. Second, a data look-up part that can be used to store the images with their associated attribute data. Third, a coordinator that is responsible for executing searches on individual indices and optimizing the integration of individual index results to form one result set ranked by overall similarity. The details of Database engine are found in [Curtis 97].

5. Evaluation

To evaluate our approach, we selected a small set of images, consisting of 227 photographs from several volumes of PhotoDisc™ <http://www.photodisc.com>, which includes Food Essentials, Retail, Shopping and Small Business, European Landmarks and Travel, Far Eastern Business and Culture, Education, Government and Social Issues, Homes and Gardens, International Sports, People, Lifestyles and Vacations.

During object extraction, on average about one hundred objects are found from each image. The number of possibly meaningless objects is, on average, 11.6 times the number of possibly meaningful objects.

As an experiment of retrieval accuracy, we gave *ExSight* the query "Give me images with people in some bluish clothes", using the multiple reference retrieval with two reference objects of a human face and a blue shirt. Two referees subjectively selected the 16 images with people in bluish clothes out of the 227 images in the sample database beforehand, which were assumed to be the correct result. Table 1 shows the results of the experiment. The relation between the number of nearest neighbor searched for, recall (percentage of correct images in the returned set out of the total correct images in the database), and precision (percentage of correct images out of the returned set). Since our approach extracts many redundant objects, the precision values are not particularly high, whereas recall values are fairly high if we request a large number of result images.

To increase the precision, or to exclude incorrect images from the result set, that is to reduce really redundant objects, are important items for further study. Adjusting the search parameters, for example the weight vector, is another subject for further study.

Table 1: Result of Experiment

Trial	1	2	3	4
Size of result set	3	6	24	74
# of correct images in the set	2	3	7	16
Recall(%)	13	19	44	100
Precision(%)	67	50	29	22

6. Conclusion and possible application areas

A database centric approach to content-based image retrieval has been proposed and techniques required to achieve this have been described. An image retrieval prototype system *ExSight*, which embodies these ideas, has been presented. *ExSight* successfully extracts meaningful objects from images during preprocessing and provides indexing methods that can outperform existing indices. Although comprehensive evaluation remains to be done, a simple evaluation with a small set of images has shown our content-based retrieval approach retrieves appropriate images in response to a query.

The system can be applied to such areas as electronic commerce, remote education or multimedia contents authoring in the WWW environment.

References

[Ashley 95] J. Ashley et al, "Automatic and Semi-automatic Methods for Image Annotation and Retrieval in QBIC," Proc. Storage and Retrieval for Image and Video Databases III, Vol.2420, SPIE (1995)

[Bombo 96] A.D.Bombo, P. Pala, S. Santini, "Image Retrieval by Elastic matching of Shapes and Image Patterns," Proc. of IEEE Multimedia Systems '96, pp.215-218, Hiroshima (1996.6)

[Curtis 97] K. Curtis, N. Taniguchi, J. Nakagawa, M. Yamamuro, "A Comprehensive Image Similarity Retrieval System that utilizes Multiple Feature Vectors in High Dimensional Space," Proc. of ICICS'97, pp.180-184, Singapore (1997.9)

[Flickner 95] M. Flickner et al, "Query by Image and Video Content: The QBIC System, " IEEE Computer, Vol.28, No.9 (1995)

[Gupta 97] A.Gupta, R.Jain, "Visual Information Retrieval," Communications of the ACM Vol.40, No.5 (1997.5)

[Ogle 95] V.E.Ogle, M. Stonebraker, "Chabot: Retrieval from a Relational Database of Images," IEEE Computer, September (1995)

[Vinod 96] V.V.Vinod, H. Murase, C. Hashizume, "Focussed Color Intersection with Efficient Searching for the Object Detection and Image Retrieval," Proc. of IEEE Multimedia Systems '96, pp.229-233, Hiroshima (1996.6)

[White 96] D. A. White and R.Jain, "Algorithms and Strategies for Similarity Retrieval," Technical Report VCL-96-101, Visual Computing Laboratory, University of California (1996)

Telecommuting
Bringing Real Bandwidth Needs to the Home

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The paper explain Indonesia TELKOM perspective about Telecommuting which to be one of application will be developed under Nusantara-21, Indonesia national information infrastructure vision. The Public Telecommuting Access Center plan to be developed in several major cities to support multimedia society in Indonesia and give an unlimited opportunities for the people without considering the social-economic status and other differential elements in order to be able to take a benefit at the existence of multimedia network capability.

Indonesia Cities & Information Infrastructure

The big cities in Indonesia these days possess the same characteristics as many others big cities problem in the world. The reject of this situation may result in stress, frustration, and bring another problems to resident who live and work in there, beside the pressure of the works itself. The Jakarta city is an example of this situation.

They are various theory about the best method or effort to get cities growing better. One is what it cells "counter-magnet' or establishing satellite city which drive by Indonesian government to solve economic and social problem in several major cities in Indonesia. According to Indonesia's National Development Planning Board (BAPPENAS) estimates that long before 2019, which marks the end of the country's second long term development plan, the country will have 15 new urban areas with populations of more Than one million each. Four of these new Indonesian cities will have over five million citizens each. It means too, up to 60% of Indonesian will live in cities. Now that government has barred more heavy industry from central metropolitan to nearby cities. The metropolitan it self is rapidly switching from industry to services cities.

It is strongly suggest that transformation will increasingly rely on telecommunications. With advances in telecommunications technology a large of volume information, processing and transaction can be transferred effectively without restricted by time or space. The contribution of telecommunications to the cities and total national economy has increased with economic development, as the use of telecommunications has been increasingly applied to a wider range of economic sectors. It includes telecommunication usage in new-information based industries such as database, software, value-added network services and also other hi-tech industries.

Nusantara-21

The condition of national information infrastructure relating with process of transformation cities urge Indonesia information society, include TELKOM as domestic telecommunication carrier in Indonesia, develop and promote telecommuting product solution. Indonesian government has commenced the vision of National Information Infrastructure (NII) which is titled "NUSANTARA-*21*" The vision to establish welfare and prosperity within the divers society which spread over the country through telecommunication and information technology utilization. That is vision behind the usage of PALAPA domestic communication satellite in 1976 which already proved strategically and effectively supporting the process of developing the whole life aspects of Indonesian people.

The Indonesian national information infrastructure is not intended to wait until the information 'superhighway' available but it's planned earlier to be an effective utilization of the available information infrastructure facilities to support the nation economic & human development program. In line with this information infrastructure will also developed to form an appropriate and effective electronic superhighway for day to day operation of the economy.

The establishment of information infrastructure, basically rely on to the fact of Indonesian society's way of life which is full of diversity and uniqueness, such as: Indonesia is an archipelago country, high population density and where the telephone density are relatively low. Also there is a disparity in the level of the social-economic. Based on the uniqueness mentioned above, national information infrastructure will be established in the three layers: Archipelagic Super Highway, Multimedia cities and Multimedia Community Access Centre

Archipelagic Super Highway is the main backbone which will connect the Nusantara's 27 provinces. The bandwidth will be in accordance with the real bandwidth needs. This backbone is evolving from 'skeleton' configuration towards 'ring of rings' configuration with the broadband bandwidth that planned to increase gradually until the year 2001. This Backbone will be the main infrastructure to support broadband service in each multimedia city.

Multimedia cities are established in several big cities and will become Multimedia cities which have multimedia community' access centers. These centers should be equipped with a reliable and sophisticated inner-city information infrastructure and various access link with appropriate bandwith availability. So that, the society in those multimedia cities can do their productive activities through information processing and transaction.

The Multimedia Community Access Centre facility is intended to reach the entire level of society' by emphasizing on the 'accessibility' rather than the density. This access point is the first and most important node to provide the society's access to the main multimedia infrastructure. This access node is built by omitting the social status and other disparity element, so that the people can take advantages from the existence of multimedia city running efficiently.

Telecommuting will be one application solution which plan to be developed to support information society's, especially in the big cities with a high population & traffic problem, like Jakarta, Surabaya and Bandung. The telecommuting public access will be build to give unlimited opportunities for people without considering the social-economic status and other differential elements in order to be able to take a benefit of the existence of multimedia network capability.

Indonesia Telecommuting Perspective

Telecommuting terms refer as the ability of workers to work outside from their office, either from their homes, satellite office or mobile. Telecommuting will use basic and advanced telecommunications technology to replace or reduce traditional commuting to the workplace.

Telecommuting also referred as "flexiplace" applies to everyone who occasionally works at remote area during busy office work period to minimize interruptions, increase productivity without physicological stress and missed family care. However, telecommuting offers not only application to make people 'just working' but also solution to maintain health, improve professionalism, manage finance and event to teach children.

Trends of telecommuting is growing everywhere all over the world since it has proved to be beneficial either to employee or employer, also to society as well. Most of the business company in Europe and America have been using this concept in any scales and have obtain several benefits to either the employees, employer and also to the community.

- **Telecommuting Classical Factors**

Indonesia perspective on telecommuting is beyond all the benefits mentioned above but telecommuting development in Indonesia is not only drive by common classical factors such as urbanisation, traffic congestion, dynamic of information technology trend and environmental concern. The latest one become seriously with the emergence of a large manufacturing sector and the recognition of the growing importance of tourism as a major employer and foreign exchange generator.

Indonesia telecommuting development is one effort to achieve the aspiration of creating the nation as an information-based society. Telecommuting approach should be seen from business, technology and social aspects, and for many strong reasons, the latest one is not quite simple for manage, in fact it is complicated enough that sometimes has made telecommuting to be rejected or failed in its field implementation.

- **Life Style & Business Culture**

Telecommuting strategy need to be identified as detail as possible to overcome critical factors. More varied, richer set of work settings that truly supports the full range of work activities have to be in clear portion of telecommuting implementation. It should be widely understood that the workplace is a complex system in which all elements must work in harmony, rather than simply change how space is assigned.

Business people in Indonesia is a best object experimental of doing this, because business approach is always looking for good innovation to make their business running effeciently. The telecommuting implementation issue probably the working method' or 'business culture'. We consider that is a big thread for telecommuting because they all firmly related with Indonesia culture', where one's respect, authority, and politely have been part of every day socializing patterns of Indonesia people and characterized them for centuries. Therefore, a new way of working, electronical way, where interactions that would previously have been carried out face-to-face will be mediated by computers, might seemed not suitable to be adopted by certain working environment. In the era of telecommuting, what is used to be a way of communicating totally different from the old ones. sets of employee arrangement have not touch the electronic communication ethic, so one should be on duty to explore aspects of this new way of working.

Communication forum in every level of the organisation is very' useful to gain the same perception and input to the program. We should identify how things related to work running in our environment Employees is used to take action regarding their managers direction, and sometimes its a matter of politeness. Life style also has big part of everyday workers activities where prestige and image speaks. Those who don't commute to their office are considered to be unemployees. Finally, telecommuting will cause changing in organization and communications structure, ft changes also the nature of centralization and decentralization matters in solving problems and making decision within an organization.

- **Technology & Human Resources**

Information technology has an important role to play in accomplishing regular tasks by telecommuting. Telephone, facsimile and voice mail were found to be important communication components in carrying out the work effectively among the employees. While dynamic change in computing technology is growing fast, ft is realized that to be a success telecommuter requires a highly skilled workforce in order to have maximum output of the program.

Further consideration about lack computing technology skills among employees has to be taken, meaning that, this new telecommuting arrangement should not make a gap between 'technological employee' and one who doesn't. Industry has already took human role in many parts of industry and business development, so telecommuting should not in any case make employee feels less worth than he was before. What also could happen for those who are not familiar with technology environment is declining of self confidence and the worst Thing will happen to the productivity of the workers. Together with this fact is that not every workers have the opportunity to own luxury' communication tools. This is the time when management and strategy of telecommuting implementation is tested. This is also the reason for all telecommuting project director to include phase and training in his project.

As costs of computing hardware decrease, and as employer acceptance of telecommuting increases, the jobs available to telecommute will be broaden to include positions at all pay and experience levels. However, telecommuting still not an "exclusive job" which needed human exclusive IT capabilities. Indonesian telecommuting will urge some job titles with "minimum" IT intention. Jobs title like data entry, telemarketer, surveyor1 consultant, book keeper, writer or language translater are potential to be done by telecommuting solution. The younger generation now is more familiar to technology devices compare to their own parents, because technology has appear in every single schools activities. Telecommuting will also bridge this gap while educating parents to use more technologies in supporting their work and promoting distance working concept. Constantly telecommuting will improve 'IT based knowledge' of society and bring the global information closer to them, not only for those who is taking hold of information technology access, but is opened for everyone who is willing to and need to have it.

- **Tele Accessibility vs Tele Density**

Development of multimedia community access centre in multimedia cities under Nusantara-21 vision will plays as central economical activity which is potential inner-city information highway and perform a complete access channel with its appropriate types and amount. So that people in those multimedia cities can perform their productive activities through information transaction in a reliable and rapid manner. Telecommuting is a common task in those cities as identification of information society and identification of NUSANTARA-21 supporting ability to the public.

Development of NUSANTARA-21 will able to cover the entire level of Nusantara society with 'accessibility' orientation. Within NUSANTARA-2i context, the concept of 'community access centers' which will include 'info communication public access, 'broadband business centers', 'networked e-library', multimedia community kiosks, is developed to provide 'flexible public accessibility". The concept has been applied in place for several years, like WARTEL (communication kiosk), WARNET (internet access kiosk), and computer rental where people have found it helpful and making community to be more familiar with information technology. Therefore to migrates this form to telecommuting centers or satellite office form might not so difficult without omitting their own characteristics. Telecommuting access centre will offer more value than others, where people who have no chance to handle their work at home could use this place by relying on network availability and reliability to support their job functions.

There are so many areas where we can put telecommuting concept effectively, like in concentrated population that possessed by major big cities. Telecommuting centers can be an opportunity offered by real estate developer, and indirectly will encourage people to make benefit of it telecommuting application, like teleservices which can also be utilized to improve access to information and government services in inner cities and rural areas by providing information via telephone, establishing mobile service programs, or satellite office closer to aggregate populations. To make this real, the word accessibility is now more important than word density.

TELKOM Telecommuting Project

The telecommuting market represents attractive business opportunities for a number of communication services providers, including TELKOM. The success of telecommuting industry not depend solely on telecommuters and their employers, but also relies on the action of telecommunication service providers. To entering and stimulating telecommuting market TELKOM has taken the following actions:

- analyze the unique characteristics of the Indonesian telecommuting market, which combines some characteristic of social, economy, infrastructure and culture in Indonesia.
- analyze target cities and vertical industry that are expected to be early adopters of telecommuting solution
- Establishing a project that will concern on telecommuting implementation planning, trials, market survey and developing suitable applications.
- Establishing alliancies with other horizontal & vertical telecommuting industry, include communication service providers, hardware manufacture or supplier and software developer to provide the telecommuters with integrated product and service offerings.

TELKOM telecommuting project encouraged from the vision of Nusantara 21 which has previously discussed in this paper. The pilot project is implemented in RisTI, information technology research division of PT TELKOM, taking form as an Satellite Office that support RisTI employee in a certain area having the biggest RisTI employees population.

The program is arranged to be simple, flexible and of course, helpful, especially for those having trouble to commute to the office. There's no significant changes in human resources regulation in drawing this program. Every workers will allowed to participate in this program and making use of the Satellite Office in performing their job, so that adaptation to this new way of working is naturally and spread evenly. Knowing better how telecommuting is work, will cause less adjustment to accept policy which is needed to avoid "trouble issues" such as jealousy between who telecommutes and who doesn't, feeling of isolation or other social problems. Anticipating if everyone would want to telecommute, policy also needed to avoid losing control of employee's work force, overwhelmed of training and equipment.

Telecommuting program is not limited to Satellite Office, it could be working at home or even mobile computing, but we believe that Satellite Office approach will be a good and effective way in transforming working paradigm from 'the place you go" to the 'things you do". It may facilitate employee who is suffer from commuting problems to the office and make them easier to rearrange their time and cost. It is related to the vision of upgrading IT based knowledge of society in given accessible community center. Management support on one side and family support on another side is responsible to make this happen.

The specific telecommuting applications which is explored in four categories: basic services, groupware, Internet Intranet and value added services will package in Telecommuting Solution Product, which ready to use by cities, companies or personal telecommuter who shown clear demand to deploy telecommuting concept. This solution will have numerous element in one comprehensive package which could be customized in services and application.

Priority considerations of telecommuting objectives will effect implementation options for Satellite Office design. This package will concern about information and education of telecommuters to get successfully telecommuting programs up and running. with TELKOM contributions in telecommunications area, particularly in providing network infrastructures, telecommuting centre will be professionally organized and maintained to become a real productive work option for employees and overcome region constraints.

Conclusion

Telecommuting consider as one of the alternative work arrangements for alleviating major problems of a city or urban center. Telecommuting in Indonesia is still at the preliminary stage of development. But, the advent of advanced information technology might lead the Indonesian company and society to consider for an alternate work arrangement to increase their productivity and competitiveness that finally will increase level standard of living in whole country.

Telecommuting initiative is only one of Nusantara-21 of milestones in bringing the Indonesian society to become the competitive citizen and have a big role in the global economic arena in future world economy in which microprocessor and networks enable fundamentally new kinds of institutional structures and relationship.

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Internet Security: Facilitator of Internet Virtual Private Networks (iVPNs)

■ A Step Toward The Future Of Pacific Rim Commerce

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1. ABSTRACT

Today, many Pacific Rim organizations have private data networks and connections to the Internet. The next step is to shift more corporate networking onto the Internet to lower costs and increase flexibility. Implementation of such a shift is called an Internet Virtual Private Network (iVPN). The gating factor for successful implementation is security and this paper presents a strategy for building a secure iVPN.

2. INTRODUCTION

What will the Internet look like in the future? Will it still be a network composed of *surfers, browsers, hackers*, and shoppers? Or, will businesses and governments use the Internet as the global backbone for commerce? The answer is unknown - what is known is in Asia the Internet is notoriously expensive, slow and unreliable. In Japan, for example, the greatest barriers to further use of the Internet are high telecom costs, high access charges, heavy traffic and slow response, low information quality, and lack of security[i]. These factors are not unique to Japan and are indicative of a Pacific Rim-wide problem. Another way to characterize these "problems" are issues of reliability, performance, cost and security. If these issues can be solved then business use of the Internet will expand.

This paper is a discussion of a new concept of *internetworking*, the Internet Virtual Private Network (iVPN). Specifically, this paper is a discussion of the iVPN with a focus on security as the gating factor for business expansion of the Internet.

3. THE CURRENT STATE OF AFFAIRS

The majority of current Internet usage is for Email and Web Browsing. A 1996 Japanese survey indicates that nearly 70% of Internet use is for email and WWW Browsing[ii]. Similar results have been found in Australia and the United States[iii]. In reality what is happening is that organizations are adding Internet access for such activities. However, this access is still in addition to the corporate backbone network.. What if organizations could use the Internet as the corporate backbone network? What if instead of needing a dedicated line between Tokyo and Kuala Lumpur you could have local access in Japan and local access in Malaysia and achieve a network that offers the same performance, reliability, and security at a much lower cost? This shift from having the Internet in addition to the corporate backbone to using the Internet as the corporate backbone is called an Internet Virtual Private Network (iVPN).

Why Internet Security?

As listed above, there are four fundamental issues which must be addressed in terms of Internet expansion: cost, performance, reliability, and security. Of these four, security is the gating factor since unless the security issues are solved it doesn't matter how inexpensive, fast and reliable the Internet becomes, it will not be successful. The reason for this is with the other factors the Internet can be utilized but not to its full potential. For example, one can use the Internet to send files between companies today - with limited performance and reliability at a relatively high cost (within the Pacific Rim). However, without proper security, no matter what level or performance, cost or reliability, the information, and the organization are open to attack.

The reason for this is that IS managers are used to a certain level of security with their current networking infrastructure. This security is generally based upon a closed network environment. Even if the network is based upon a public networking technology such as frame relay or X.25 there is still a belief (maybe valid or not) that the network is secure. In contrast, the Internet is the most open network in the world. Therefore, the IS managers understand that as soon as they open the corporate network to the Internet they are opening-up serious security risks. An iVPN asks these managers to go one step further and not just open up their network but to actually shift their corporate resources to the Internet.

4. THE CONCEPT OF VIRTUAL PRIVATE NETWORK

A Virtual Private Network is a concept that has been around for many years in the voice networking world. In the late-1980s large carriers started to offer VPNs for voice services so that companies could have the appearance of a private voice network while sharing the resources of a much larger network. This concept is now being applied to the data world, to the same effect. Essentially, a VPN for data is the building of a data network that appears to be "private" while utilizing the resources of the much larger data network. The specific topic that this paper addresses is the use of the Internet to create a VPN. Another way to consider this is the building of a Corporate *Intranet* across the Internet.

What are the business drivers for the iVPN? From an intuitive standpoint it makes sense to utilize the scope and scale of the Internet for corporate communications. However, why would a company want to take the risk of putting their data across the Internet? Based upon experience in the United States, there are two fundamental reasons for building an iVPN: cost and flexibility. First, cost is a critical driver between any networking decision. There are some very interesting dynamics set today in the Internet networking area. These are:

- Most networking options are either distance sensitive or usage sensitive. For example leased line networks are priced based upon line rate and line distance.

- The Internet, for the most part, is priced based upon access speed. This means that it costs the same to send a packet of information from New York to Boston as it does from New York to Tokyo. This fact is one of the core drivers behind the economics of iVPNs.

- In the United States the ISP market is extremely competitive. This competition is driving down Internet access charges quickly to near commodity rates. What this means for the consumer is an Internet that is inexpensive to join but highly congested due to the flat rate prices. The ISPs are looking for ways to differentiate their service in the market and one of the keys to doing this is by adding value added services such as iVPNs.

The other business driver with regard to iVPNs is flexibility. As the Global Economy becomes more competitive and organizations depend more heavily upon digital communications, the need to quickly and efficiently communicate with multiple partners is paramount to success. Corporations are not only concerned with connecting their own operations together via the corporate network, but are also concerned with connecting partners and customers as extensions of their corporate network. This extending of the corporate network is called an *extranet*.

Today, companies are faced with extending their corporate networks to partners and customers via leased lines, frame relay, and or/X.25. All three of these technologies require long lead times for the carriers (particularly in second and third world nations) to provide access for the corporate partners and customers. At the same time, however, the Internet is becoming the most accessible network in the world. There are many times where dedicated lines cannot be provided but the Internet is available for access. This results in increased flexibility and competitiveness for organizations building the iVPN.

These dynamics, particularly in the United States leads to an incentive for the ISP to provide iVPN service and for the customer to ask for iVPN services, resulting in a win-win situation.

4.1 WHAT ABOUT THE DIFFERENCES BETWEEN THE INTERNET IN THE UNITED STATES AND THE PACIFIC RIM?

There are some general trends occurring which indicate that dramatic changes are underway which will yield an Internet market in the Pacific Rim similar to that of the United States. These trends include:

PTT deregulation - For example, the gradual deregulation of NTT has spawned a host of competitive New Common Carriers, many of which are planning ISP services. In addition, NTT itself has dramatically lowered the price of Internet through its OCN offerings.
Expansion of Global Internet providers - The expansion of such providers as BT/Concert, Global One, and WorldTel are resulting in higher availability, reliability and a lower cost of Internet access.

Support of multinational organizations - Organizations such as OECD, ASEAN, and G7 have all targeted the growth of Internet as critical for the future success of Global electronic commerce.

Assuming that these factors are true then the Internet in the Pacific Rim will evolve from the high cost, low reliability Internet of today to a more cost-effective and reliable network in the future - a network that supports the development of iVPNs.

5. INTERNET SECURITY

As stated above, proper security implementation facilitates the implementation of an iVPN. However, the foundation of a good security implementation is understanding the risks associated with the Internet. The Internet, by it's nature is an open environment. Based upon technology and concepts from the 1970s the Internet was originally developed to be a research network where the requirements for access and availability far outweighed the requirements for privacy and authenticity. After all, the Internet was developed by an elite group of researchers, for an elite group of researchers. Times have changed and now the Internet is being faced with demands for security of the level achieved only in private networks up until this date. This is a critical point since without high-level security, the Internet will never achieve it's potential of becoming the commerce highway of the future.

There are different approaches to iVPN implementation with regard to security. This paper outlines a complete iVPN security offering based upon the Internet Engineering Task Force (IETF) IP-Security (IPSEC) specifications. There are simpler means to build Internet security systems than that proposed in this paper. However, the assumption here is that the Internet iVPN should offer the same level, or even higher level, of security that the organization is experiencing today and this calls for a very thorough implementation.

5.1 PROTECTING IVPN DATA - WHERE'S THE RISK?

Where will the attacks come from? Attacks can come both from within the iVPN as well as from outside the iVPN. For example, in an attack on a Fortune 500 customer the easiest attacks were not through the Firewall but rather through fax servers and remote modems on users desktops where the default passwords had not been changed.[iv] Through these "backdoors" the *hackers* (a paid group organized by the company being attacked) were able to break into every major computer system in the corporation.

The first step in preparing for attack is to have a security policy. Surprisingly, this simple step is overlooked by the majority of companies. In Japan, for example, security is a fundamental assumption of society and this belief system is reflected in corporate security planning.[v] In a Japanese survey nearly 35% of the users surveyed gave no consideration to data security.[vi]

6. THE DEFENSE - HOW TO MOVE DATA ACROSS THE INTERNET SECURELY

To move data across the Internet securely (enabling an iVPN) there are four fundamental questions that must be answered:

1. Is the information private?
2. Is the data sent the same as the data received?
3. Who is the source of the data?

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4. Is the control system secure?

If solutions are developed that answer these four questions then a secure iVPN is possible. If however, any of these questions is not fully answered then there will be a hole in the security of the iVPN making it impossible to have a successful implementation. The steps outlined are summarized in Table 2.0.

6.1 IS THE INFORMATION PRIVATE?

The first step in securing an iVPN is encryption. There are many different algorithms for encryption and they all have different pros and cons. Within the Pacific Rim there any many "favorite" algorithms in use today. These algorithms include FEAL, Misty, DES, RSA, MD5 and many others. In general there are two aspects of an algorithm which must be considered: key length and strength of the algorithm. Most people are aware of the key length and that is the only aspect of strength that they focus on. However, key length alone is not necessarily a good indication of total strength; one must also consider the algorithm.

For iVPNs it is important to select an International standard algorithm. There are three reasons for this statement: testing, interoperability, and liability. First, standard algorithms go through extreme testing, known as vetting. These algorithms are developed by cryptography experts from around the world and are the most tested algorithms commercially available today. Second, the Internet, by its nature, demands high levels of interoperability. This interoperability is for communication between different countries, different companies, and different vendors products. Acceptance of an International standard is the best guarantee for interoperability as the iVPN is extended beyond the borders of one's country. Finally, what happens if the encryption is broken? What is the liabilitiy? This issue is of great importance and today there are no International liability standards for encryption. In fact, in many countries including Japan there is no limitation of liability for implementation of an encryption system. However, in the future, limited liability will have to be addressed in terms of expansion of Internet services, particularly if the services are financial in nature.

6.2 MEASURING THE RISK

How do you decide which algorithm to choose? At the time of writing there is much focus on DES encryption and its relative strength or weakness. This algorithm which is over 20 years old is still the most commonly used algorithm among banks in the United States. However, DES can be broken and the risk must be weighed when evaluating an iVPN. The key issues are the relative value of the data being encrypted and the "life" of the data. A matrix can be developed where data is mapped into a table consisting of these two factors. Table 1.0 indicates some of the types of data that can be evaluated.

Value/Life	**Short**	**Long**
Low	General Email Inter-office	Facilities Info Corp. Policies
High	Price Quotes Finan. Trans.	Plans Personnel Info.

Table 1.0 - Risk Matrix

Once the table is created then the risk can be evaluated versus the type of algorithm chosen. With increasing computing power and increasing criminal interest in the Internet the relative strength of algorithms rapidly decline over time. Today, DES-56 is fully adequate for most information on the Internet, however, over the next few years there will be a complete shift away from DES-56 to stronger algorithms.

6.3 IS THE DATA SENT THE SAME AS THE DATA RECEIVED?

Packets of information traveling across the Internet are susceptible to being "grabbed" and modified. The simplest modification is the spoofing attack where the source address is modified. A more complex attack involves changing the actual user data that is inside the packet. The solution to protecting data is via message and packet authentication. Surprisingly, these simple and common attacks are difficult for most firewalls to protect against.

The Internet Engineering Task Force (IETF) has defined a standard means by which packets can be protected as they traverse the Internet. This standard is the Encapsulated Security Payload (ESP) as defined in RFC 1827. The purpose of this standard is to protect against tampering of the packet as it traverses the network. All ESPs are not the same, however, some consist of a transform indicating the packet is encrypted. More sophisticated ESPs contain a (prevents "replay" attacks) and a Message Authentication Code (MAC). The MAC uses an encryption process to create an authentication code which prevents a *hacker* from modifying any data in your packet including the source address field.

6.4 WHO IS THE SOURCE OF THE DATA?

You may be assured that the transmission of the data was secure, the data was sent was not modified, but how do you know the identity of the sender? The process for this is called User Authentication. User Authentication (UA), like packet authentication and encryption can take many forms. The simplest form of (UA) is the password. However, passwords are exceedingly easy to break and provide limited security. The type of UA that must be invoked for clear authentication is called a "two-factor" authentication where there is something "the user has" and something the "user knows." An example of this would be the use of a PIN number and a user token (smart card, random number generator, etc.).

There are a number of authentication systems on the market today. Some use a token in random number generator that is in synchronization with a host process. Others, use a challenge/response system, and others use a simple password entry. Most systems today are designed for non-Internet use. In other words these systems are designed for users who are connected via dial-up or dedicated connections. In these more traditional applications the transmission of the data is relatively secure given the closed nature of today's PSTN and leased line networks. However, the Internet introduces much greater risk for these systems. For example, someone can "sniff" the session with the authentication host and gain the password for the user. Even with tokens that change numbers frequently there is still the risk of someone "grabbing" the password number off the Internet and logging in to the host while the password number is still valid.

What is required for secure Internet and secure iVPN is a system where there is always a random password (one-time password) and the information is protected as it traverses the Internet. Requirements include:

- The password is never sent across the Internet "in the clear."
- The password is based upon a random number generation.
- A two-factor authentication which means the user has their own PIN number and some other device.
- Authentication on a session-by-session basis. Proper User Authentication will establish a security relationship between the user and every server accessed. The user might be able to connect to one host securely and be denied from connection to another host based upon centrally managed security parameters.

The bottom-line is that this is a critical part of iVPN security and must not be overlooked.

6.5 IS THE CONTROL SYSTEM SECURE?

Control is critical to the success of the system. Control refers to the implementation of security management to operate the system. This is a broad topic that encompasses many aspects of the system including: configuration management, access management, key management, internal control management, and firewall management.

The critical issue is that such management should have complete control over the security system. This complete control is particularly critical in the area of revocation of privileges for users. If an employee leaves the organization their privileges must be immediately revoked. This is a fairly easy task when the employee is stationed in a corporate location. However, when the employee is a *telecommuter* that might be connecting into the organization through the Internet from anywhere in the world, at any time, this becomes a more complex task.

6.5.1 KEY MANAGEMENT

At the core of management is key management. For this level of discussion it is important to

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understand that key management, or more importantly, how key management is implemented is critical to the success of the system. For example, one could have the strongest encryption available, and the best user and packet authentication, but with weak key management the whole system is compromised.

There are two generic types of key management: private (sometimes referred to as symmetric) and public. Private key is typically what is implemented by Banks and other organizations who want to have a closed user community with complete central control. The most implemented form of private key management today is the United States ANSI (also ISO) standards for private key management called X9.17. Public key is based upon an open user community where keys are negotiated in the public domain based upon a public key that is stored in a certificate at a certificate authority. In the Pacific Rim, in particular this has much interest. There are many Electronic Commerce (EC) projects that are underway in the Pacific Rim that are based upon public key management. Public key management for the Internet (an evolving standard) as defined by the IETF is ISAKMP/Oakley. ISAKMP/Oakley will soon be ratified and accepted and will be the key management protocol for iVPNs based upon a public key architecture.

In summary, if all steps are not implemented, all questions answered, and all risks assessed then a secure iVPN is not possible. The standards for each of these functions is outlined in Table 3.0.

7. EXAMPLES OF AN IVPN

There are two examples of an iVPN discussed below. Both of these are examples from the United States. Unfortunately, iVPN is very new and there are few examples of iVPNs, particularly Pacific Rim based iVPNs. However, the concepts and applications that are discussed are just as relevant in the Pacific Rim as in the United States since the end-user requirements are shared around the globe.

7.1 A GOVERNMENT CONTRACTOR

Figure 1.0 depicts a large United States Government contractor. This company is based in Washington DC and has a large office in the midwest of the United States. This company is using the Internet for all data communications between its offices and between its remote employees and the organization. The salient points for this iVPN example are:

- Cost Savings - This iVPN results in significant cost savings since the cost of purchasing local Internet access is lower than the cost of dedicated lines.
- Central Security Management - This iVPN has a security management workstation where the customer performs all of their own security management. This is a requirement of their security policy which states that all security management be performed in-house.
- Central Firewall - The company has a policy that all non-secure Internet access be done through the main firewall at the HQ. This results in reduced firewall expenditures and better firewall management.
- Security For Traveling Executives - The remote uses connect through the Internet so wherever in the world they may be they only require local access. As stated above they are of course authenticated using a two-factor authentication (smart card and PIN number).
- Security and Flexibility For Temporary Workers - Being a Government Contractor they have employees who need to be on-site at Government locations for extended periods of time. This provides these employees the most efficient and cost effective means to connect back to the HQ site. Even LAN-to-LAN communications is possible through local ISP connections from the various Government sites.

7.2 AN AUTOMOBILE MANUFACTURER

Figure 2.0 depicts an iVPN for a large United States-based automobile manufacturer. This example is indicative of any large manufacturer. The primary application of this network is to connect parts suppliers with the manufacturer.

Before the iVPN the manufacturer was operating a very expensive world-wide secure network for its suppliers, partners, and international offices. The transition to an iVPN is ongoing and will be implemented in phases. The salient points of this implementation with regard to the iVPN are:

- Cost - Again, cost was a major consideration in switching to the iVPN. The current secure X.25 network is extremely expensive. By switching to the Internet the manufacturer can save significant amounts over the current infrastructure. The savings are so great that the pay back on the iVPN technology is less than one year.
- Increased Productivity - The Internet already offers higher performance in the United States than X.25 networks and this trend will continue around the world. This manufacturer is dependent upon moving large CAD/CAM files around the world and every improvement in performance results in increased worker productivity.
- Increased Flexibility - As a manufacturer competing in today's competitive economy flexibility is critical. Previously, to bring on a new supplier or design partner would take extensive planning and time to extend the secure network onto the premise of the intended partner.
- Today, with the iVPN all that is required is that the partner receive a secure application (software and/or hardware) and gain local Internet access. The bottom-line is that the Internet is becoming the most accessible network in the world, even in the Pacific Rim. Certainly, the connections may not be the highest performance or highly reliable but for this manufacturer the ability to get a new supplier online quickly still offers great value, despite poor performance and limited reliability.
- Outsourcing of Security Management - This manufacturer, unlike the above example has decided to outsource the security management of the network to a carrier.

As indicated these examples are only a subset of the possibilities of an iVPN. However, the examples highlight the use of security to facilitate LAN-to-LAN, remote-to-host, inter- and intra-company communications, and two options for security management.

8. CONCLUSION

This paper began with the question of the future of the Internet. There are some underlying assumptions that this paper is based upon include the belief that the Internet will continue to evolve throughout the Pacific Rim and this evolution will drive the Pacific Rim Internet to become more cost effective, more reliable, and more powerful. As stated above these factors are critical to the development of iVPNs. However, not nearly as critical as security.

8.1 WHAT IF THE INTERNET DOES NOT EVOLVE IN THE PACIFIC RIM?

This is a critical question since the development of iVPN adoption is directly proportional to Internet evolution. If the Internet continues to be slow, expensive and unreliable then iVPNs will have limited success. However, there will still be cases where iVPNs will be justified. The most likely implementations of iVPNs will be those which rely upon International connections. The reason for this is that the price differential between International leased lines and using Internet is far greater than the price differential between domestic leased lines and Internet. Therefore, there is the most to be gained, economically by switching to an International iVPN. In addition, the growth of Global Carriers such as BT/Concert and GlobalOne will significantly impacting the performance and reliability of International Internet communications throughout the region.

8.2 THE IVPN AS CATALYST FOR INTERNET GROWTH IN THE PACIFIC RIM

Could the iVPN drive the development of a more cost effective, more reliable and more powerful Internet in the Pacific Rim? The answer to this question is yes! There exists a push-pull relationship with regard to iVPNs, end-users, and ISPs which contributes to the development of iVPNs and the conditions that best support iVPNs. On the push side there is the user community that sees the potential value of iVPNs in terms of increased flexibility, decreased cost, and increased productivity. The demand of users will push the ISP and communication vendor market to offer iVPN service offerings and products. On the pull side there is a need for ISPs to attract more business users to their Internets and thus more revenue. As stated at the beginning the current business use of the Internet in the Pacific Rim is largely email and web browsing, no different than that of home users. As described in this paper an iVPN is fundamentally a different application of the Internet and as such allows the ISP to offer differentiated services at differentiated pricing for business users. Together, these factors will drive the market for expansion of iVPNs.

8.3 INTERNET SECURITY - THE GATING FACTOR

Finally, as described in this paper Internet security is the key to the development of iVPNs - the enabling technology. If the questions posed in this paper are answered a successful iVPN will be possible. This iVPN is the first step on the road to the future of Pacific Rim commerce in the next century:

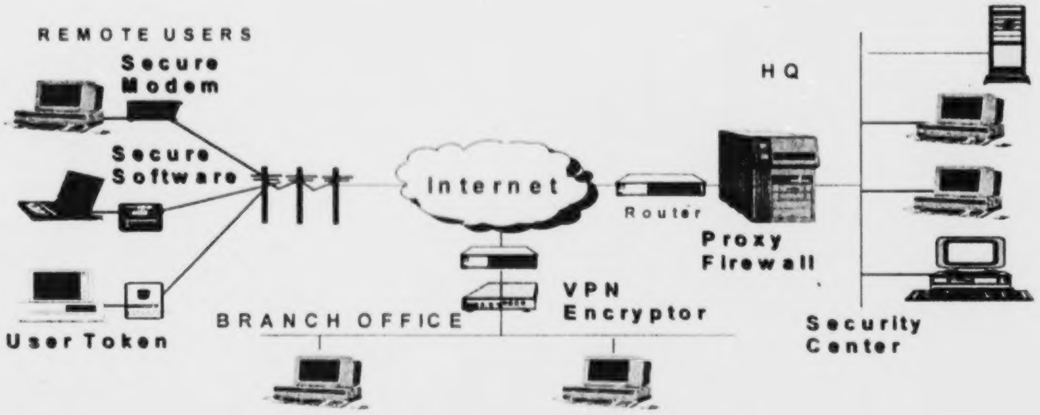

Figure 1.0 - Government Contractor iVPN

Business Requirement	Technological Solution
Keep communications private	Industry standard and proven encryption
Data arrives from legitimate source	Packet and Message authentication in real-time
User is who they "claim" to be	Continuous user authentication through the use of tokens and one-time passwords
Management of the network, the users, and the resources	Centralized security and key management based upon industry standards including ANSI X9.17 and IETF ISAKMP-Oakley

Table 2.0 - Steps For iVPN Implementation

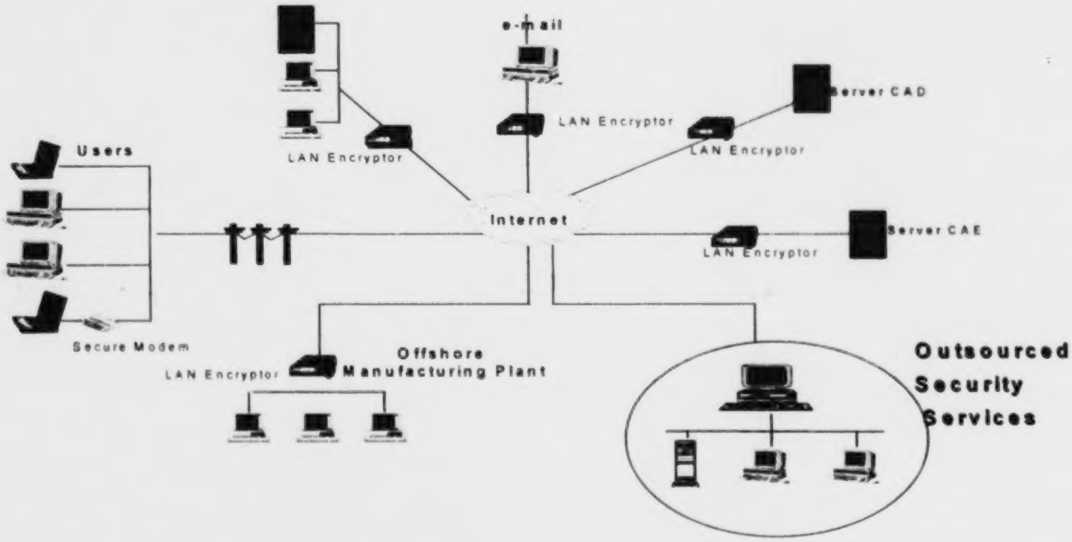
e-mail
LAN Encryptor
Server CAD
LAN Encryptor
LAN Encryptor
Users
Internet
Server CAE
LAN Encryptor
Secure Modem
LAN Encryptor
Offshore Manufacturing Plant
Outsourced Security Services

Figure 2.0 - Automobile Manufacture iVPN

Security Service	ANSI	FIPS	ISO	IETF
Encryption	X3.92, X3.106	FIPS 46, 74, 81	8372, 10116	1829
Message Authenticaiton	X9.9, X9.19	FIPS 113, 180-1	9797, 8731	1826, 1827, 1828, 1852
User Authenticaiton	X9.26	FIPS JJJ (draft)	9798, 11131	1334
Secret Key Management	X9.17, X9.24	FIPS 171	8732, 11568	-----
Public Key Management	X9.42 (draft)	-----	9594-8, 11770-3	OAKLEY/SKIP/ ISAKMP
Certificate Authority Format	X9.57	-----	9594-8, X.509	X.509 (PKIX draft)
Digital Signature - DSS	X9.30	FIPS 185	9594-8	-----
Digital Signature - RSA	-----	-----	9796	-----
Internet Security Architecture	-----	-----	-----	RFC 1825

Table 3.0 - Security Standards

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[i] "Computer and Network Security in Japan," Japan Research Institute, Limited, page 9, 1996.

[ii] ibid, page 9.

[iii] Presentation by Gerard Walsh, Deputy Director ASIO (Retired), "Secure The Web" seminar, Sydney Australia, 1997.

[iv] Behar, Richard, "Who's reading your email," Fortune Magazine, 2/3/97.

[v] Conversations with Japanese Executives at an Internet Security Seminar, Osaka, 1997.

[vi] op. Cit. Japan Research Institute, page 12.

Secure Electronic Payment for Tele-Shopping

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ABSTRACT

Shopping systems using telecommunication technology have been receiving more and more attention because it allows cost reduction for merchants and provides convenience for consumers. To make them practical to our life, however, there is a critical problem to be solved: secure payment over networks. In this paper, we describe the implementation of secure electronic payment protocols for tele-shopping: the SET(Secure Electronic Transaction) protocol for credit card payment and the SSNS(Separate Serial Number Server) protocol for electronic cash payment. Credit cards are used worldwide in the real world and their payment process is implemented into electronic payment systems easily, while the electronic cash is useful especially for low priced purchases or for purchases requiring anonymity.

1. INTRODUCTION

As the capacity of telecommunication increases, the technology is evolving from a way of communication into a way of making human life convenient, expedient and comfortable. It has been providing various services such as tele-medicine, distance education, tele-banking, tele-shopping, to mention just a few. Especially, the tele-shopping service has been receiving more and more attention all over the world because it allows cost reduction for merchants and provides convenience for consumers. According to the report of the Yankee group, a research group in the United States, 35 percents of the American companies answered that the business they are interested most on the internet is the electronic commerce.

There are two main technical issues that should be considered when we implement a tele-shopping system. One is how to find the goods that a consumer wants to purchase. A lot of research has been done in this area. Today's multimedia presentation and search technologies provide an easy, accurate, and fast solution. The other is how to secure electronic payment. Electronic payment systems should be able to provide secure transmission of financial information shielded from the dangers of criminals.

In this paper, we describe the secure electronic payment protocols developed for our tele-shopping system. To meet various users' requirements, we have developed two kinds of payment systems: the encrypted credit card payment system and the electronic cash payment system. The advantage of credit card payment system is the fact that users can use their current credit card in the electronic world as well as in the real world. We adapted the SET(Secure Electronic Transaction) protocol[Master 97][Visa 97] to our credit card payment system. The SET protocol is the enterprise standard for credit card payment systems. The second system, electronic cash payment system, is useful when users make low priced purchases or do not want to the information about purchases to be known. We proposed and implemented the SSNS(Separate Serial Number Server) protocol for the electronic cash payment system. The SSNS protocol separates the serial number management server from the electronic cash withdrawal server while the two functions are combined into one server in the other electronic cash protocols. This way, the SSNS protocol guarantees complete anonymity to keep the payment information private.

The paper is organized as follows. Chapter 2 reviews general security issues of electronic payment and introduces some electronic payment models. In chapter 3, two electronic payment systems of our tele-shopping application are described. Chapter 4 concludes the paper with a brief discussion on some practical issues.

2. ELECTRONIC SECURITY AND ELECTRONIC PAYMENT

In electronic payment systems, it is very important to provide secure electronic transactions. This chapter introduces the general issues of electronic payment systems. In section 2.1, we introduce the kinds of attacks on security and the cryptosystems that safeguard financial information from various attacks. In section 2.2, the requirements for electronic payment systems and some electronic payment models are described.

2.1 ATTACKS AND CRYPTOSYSTEMS

The malicious attacks on electronic commerce can be divided into three categories: system attack, data attack, and business attack[Lim 97]. The system attack is made by someone who destroys the information of the system illegally. System administration and security policy should be made to prevent it. The data attack is made on data within the system or in transmission over networks. The solution is to maintain confidentiality and data integrity. The business attack is a kind of swindle. So, the laws, regulations, electronic cryptosystems, and so on should be provided to prevent it.

To prevent the attacks, cryptosystems play an important role. There are two kinds of cryptosystems: symmetric cryptosystems and asymmetric cryptosystems. The symmetric cryptosystems are conventional cryptosystems which encrypt and decrypt a message using the same key symmetrically. They are also called one-way cryptosystems or private-key cryptosystems. The asymmetric cryptosystems encrypt and decrypt a message using a pair of different keys: one key is public and the other private. They are also called two-way cryptosystems or public-key cryptosystems.

In the private-key cryptosystems, the number of keys increases exponentially as the number of network users increases since such a private-key is owned only by the two users in communication. In contrast, the public-key cryptosystems have the advantage that they solve the problem by making each user's encryption key public and keeping the decryption key private to the owner only. In the following subsections, we describe the two widely used cryptosystems.

2.1.1 THE DES CRYPTOSYSTEM

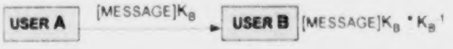
The DES(Data Encryption Standard) is one of the symmetric cryptosystems[Diffie 76] [Ehrsam 78]. It was set forward in 1977 by the National Bureau of Standards in the United States. In the DES system, both the sender and the receiver of communication must know the same secret key, which is used for both encryption and decryption. It enciphers 64-bit blocks of data using a 56-bit secret key(actually 64 bits including 8 parity bits). Its main advantage is very high encryption/decryption speed. Although recently decertified, it is still widely used and worthy of study.

2.1.2 THE RSA CRYPTOSYSTEM

The RSA(Rivest, Shamir, Adleman) is one of the asymmetric cryptosystems[Rivest 78]. The RSA cryptosystem is based on the belief that modular exponentiation with fixed exponent and modulus is a trap-door one-way function. Let p and q be two large distinct primes, $n = pq$ and e be some integer relatively prime to $(p - 1)(q - 1)$. Each such triple $k = < p, q, e >$ is a private key for the RSA cryptosystem. The pair $< e, n >$ is known as the public key, and it is easily computed from the private key $< p, q, e >$. It is difficult(presumably), however, to obtain the private key from the public key. The difficulty is proportional to the length of the key. The RSA cryptosystem is known as a very reliable cryptosystem so far, but the series of modular multiplications makes its processing speed slow.

Figure 1(a) shows the encryption and decryption process of the RSA. First, the user B once and for all makes his/her public key K_B and makes it available in the users' directory, whereas he/she keeps his/her private key K_B^{-1} secret. This enables any other user to encipher messages that only the user B can decipher. If the user A sends the user B the message enciphered using K_B, the user B decipher it using K_B^{-1} which can not be computed from K_B.

The RSA cryptosystem also implements the digital signature which enables user authentication(Figure 1(b)). If the user A wants to send a signed message to the user B, he/she enciphers the message using his/her private key K_A^{-1} and enciphers it again using user B's public key K_B. The user B makes sure that the message is signed by the user A after he/she deciphers it with his/her private key K_B^{-1} and user A's public key K_A.



(a) PUBLIC-KEY ENCRYPTION AND DECRYPTION.

USER A
$[[MESSAGE]K_A^{-1}] K_B$
USER B
$[[[MESSAGE]K_A^{-1}] K_B * K_B^{-1}] * K_A$

(b) RSA BASED DIGITAL SIGNATURE.

Figure 1. RSA CRYPTOSYSTEM.

2.2 ELECTRONIC PAYMENT MODELS

To design an electronic payment system that meets users' requirements well, some features are suggested to be included in the system. Neuman and Medvinsky proposed security, reliability, scalability, anonymity, acceptability, customer base, flexibility, convertibility, efficiency, ease of integration with applications, and ease of use as the requirements for electronic payment systems[Neuman 95]. Panurach proposed security, speed, privacy, decentralization, and internationalization [Panurach 96]. Some of these characteristics are more important in some communities, or for certain kind of transactions, than they are in other communities.

Various electronic payment systems called credit card payment systems, credit cash payment systems, electronic cash payment systems, electronic check payment systems, electronic wallet payment systems, and so on have been developed. Each of them meets the above requirements more or less than the others. Some credit card payment systems and electronic cash payment systems are developed commercially already and will be popular payment systems. This section describes advantages and disadvantages of the two.

2.2.1 THE CREDIT CARD PAYMENT SYSTEMS

The credit card payment system has a large practicability in the electronic world since credit cards are popular payment media in the real world and the credit card payment system accepts current credit card members. Users do not have to have extra software or accounts for the credit card payment system. However, privacy is not guaranteed since the credit card information can be traced. Micropayment - the payment for a good which costs little - is not supported, neither.

Visa, Master, GTE, IBM, Microsoft, Netscape, SAIC, Terisa Systems, and Verisign developed the SET protocol for credit card payment[Master 97][Visa 97]. The SET protocol is the enterprise standard. It employs the digital envelope cryptosystem which takes the advantage of the speed of the DES cryptosystem and the reliability of the RSA cryptosystem.

Some companies in Korea have plans to build electronic commerce systems which support the SET protocol. A SET system planned to be built in Korea by Korea Telecom and Master. They will provide an internet virtual shopping mall based on the SET security in 1998. IBM Korea is also planning to provide an electronic commerce solution based on the SET protocol.

2.2.2 THE ELECTRONIC CASH PAYMENT SYSTEMS

Electronic cash provides users with the advantages of cash: anonymity and micropayment. When we do not want to be known what, how much or where we buy, we can buy goods with cash in the real world. The electronic cash provides this anonymity in the electronic world. It is also very useful in the case of micropayment. When we buy a low priced good in the real world, we pay in cash rather than a credit card since the cost of the credit card payment transaction is too much in comparison to that of the good itself. Thus we pay in electronic cash for a low priced good in the electronic world.

In general, electronic cash is supposed to provide reliability, privacy, protecting double spending, transferability, and changeability[Park 96]. The reliability is provided by protecting electronic cash from unwanted copy or forgery. The privacy is guaranteed by making pay information untraceable. The double spending of electronic cash can be prevented by managing electronic cash with its serial number. Electronic cash should be able to be transferred from a person to another or be changeable into small ones, as cash is in the real world.

There are two kinds of electronic cash payment systems. One system saves its value in IC cards or electronic wallets and pays off-line. This kind of electronic cash payment systems, for example Mondex Smart card in England[Mondex 97], are wide spread in Europe. The other supports electronic commerce over networks like internet or PC networks. Electronic cash payment systems in the United States are usually adapts this way of processing. They are based on the PC with a wallet plug in. CyberCash is one of the examples[CyberCash 97].

In Korea, several associations and companies are planning to develop electronic cash systems. The CCPAK (Computer and Communications Promotion Association of Korea) organizes working groups for electronic cash and integrates the above two kinds of electronic cash payment systems to establish the electronic cash model of Korea. The Bank of Korea is planning to develop the electronic cash payment system which saves value on a IC card. Korea Telecom proposed the SSNS protocol for secure electronic cash payment. This protocol will be described in the section 3.2.

3. IMPLEMENTATION OF ELECTRONIC PAYMENT SYSTEMS

We have been developing a tele-shopping system called TeleSHOP[Paik 96] which supports two secure electronic payment systems: the credit card payment system based on the SET protocol and the electronic cash payment system based on the SSNS protocol. So the user of TeleSHOP can pay in either credit card or electronic cash according to his/her preference. We describe the two payment systems in the following sections.

3.1 THE CREDIT CARD PAYMENT PROTOCOL

Our credit card payment protocol is based on the SET protocol specification. In this protocol, information is encrypted in the digital envelop which integrates the private-key cryptosystem DES and the public-key cyptosystem RSA. The RSA cryptosystem is well known as a highly reliable cryptosystem so far, but the high encryption/decryption cost is its weakness. The cost becomes higher as the length of the target message becomes longer. So the the digital envelope enciphers the long message by the rapid DES cryptosystem and the short DES key by the RSA cryptosystem. It makes the digital envelope encrypt/decrypt the long message rapidly, while it achieves the reliability of the RSA cryptosystem.

The credit card payment system is composed as shown in Figure 2. The payment server is an intermediate server. After the consumer decides to buy something, he/she sends OI(Order Information), PI(Payment Instruction) and DI(Delivery Information) to the payment server. The payment server acknowledges the OI and requests virtual payment to the VAN server by sending the PI. The VAN server processes the virtual payment and sends virtual payment confidence to the payment server. Finally, the payment server sends the DI to the merchant so that he/she delivers the ordered goods to the consumer. The actual payment is done on the prefixed date of the credit card payment.

While the credit card payment is being processed, information is encrypted in a separate digital envelope so that security is guaranteed. In the process 1 of Figure 2, the OI is encrypted using the public key of the payment server, while the PI and the DI are encrypted using the public keys of the VAN server and the merchant respectively. These digital envelopes prevent information falsification.

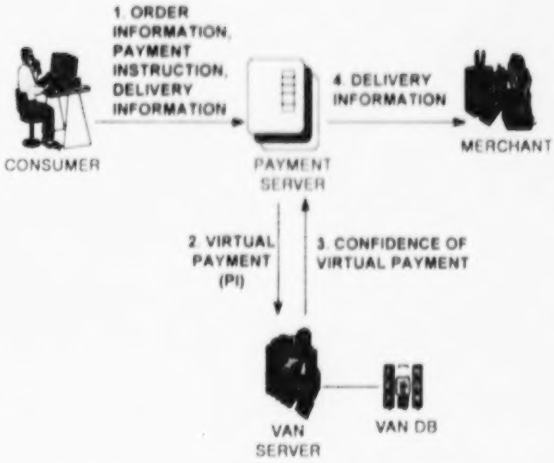

1. ORDER INFORMATION, PAYMENT INSTRUCTION, DELIVERY INFORMATION
4. DELIVERY INFORMATION
CONSUMER
PAYMENT SERVER
MERCHANT
2. VIRTUAL PAYMENT (PI)
3. CONFIDENCE OF VIRTUAL PAYMENT
VAN SERVER
VAN DB

Figure 2. CREDIT CARD PAYMENT SYSTEM.

3.2 THE SSNS PROTOCOL

It is difficult to trace the flow of cash or to forge cash in the real world. So cash provides complete anonymity and protects double spending. Existing electronic cash systems protects double spending by managing electronic cash with its serial number, but they do not guarantee complete anonymity since they withdraw cash and manage its serial number at the same server. The server knows the user's financial information since it withdraws electronic cash from his/her account. It also distinguishes the serial numbers of electronic cash because it manages them. So the server knows which electronic cash was withdrawn by whom. It is also a problem that the serial number is given by the first user in the systems. It violates the uniqueness of electronic cash.

We separate the electronic cash withdrawal server of a bank from the serial number management server so that the electronic cash payment protocol provides complete anonymity. The bank do not know the serial number of electronic cash and the serial number server do not know who requests the withdrawal of the electronic cash. The protocol is called the SSNS protocol.

The SSNS system is composed of a user, a serial number server, and a bank. The user has an account in the bank and requests electronic cash withdrawal. After the user withdraws electronic cash, he/she pays in it or deposits it in his/her account. The serial number server issues serial numbers and manages them to protect double spending of electronic cash. The bank exchanges money in users' accounts for electronic cash.

The SSNS protocol has three phases: withdrawal phase, payment phase, and deposit phase. We will describe these three phases in the following subsections.

3.2.1 THE WITHDRAWAL PHASE

Figure 3 shows the electronic cash withdrawal phase. When the user requests electronic cash withdrawal, the serial number server creates a new serial number for new electronic cash. The serial number server encrypts the new serial number using its public key in order to provide anonymity and to protect double spending. Then the encrypted serial number is sent to the bank. The bank withdraws new electronic cash from the user's account and gives the serial number to the electronic cash. After that, the bank sends the acknowledgment of the withdrawal to the serial number server so that it saves the amount and the serial number of the electronic cash. These saved values are used later for checking validity and double spending. Finally, the bank sends the electronic cash to the user. The electronic cash provides complete anonymity since the bank does not know the serial number which is encrypted using the public key of the serial number server and the serial number server does not know the purchase of the electronic cash corresponding to the serial number.

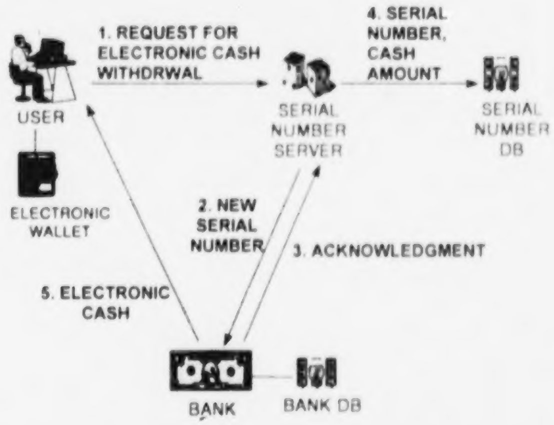

1. REQUEST FOR ELECTRONIC CASH WITHDRWAL
4. SERIAL NUMBER, CASH AMOUNT
USER
SERIAL NUMBER SERVER
SERIAL NUMBER DB
ELECTRONIC WALLET
2. NEW SERIAL NUMBER
3. ACKNOWLEDGMENT
5. ELECTRONIC CASH
BANK
BANK DB

Figure 3. ELECTRONIC CASH WITHDRAWAL PHASE.

3.2.2 THE PAYMENT PHASE

Figure 4 shows the electronic cash payment phase. The payer encrypts electronic cash using the receiver's public key and sends it to the receiver. The receiver asks the serial number server whether the electronic cash is valid or not. The serial number server acknowledges validity and gives the new serial number to the electronic cash in order to protect double spending. Finally, the receiver receives the valid electronic cash.

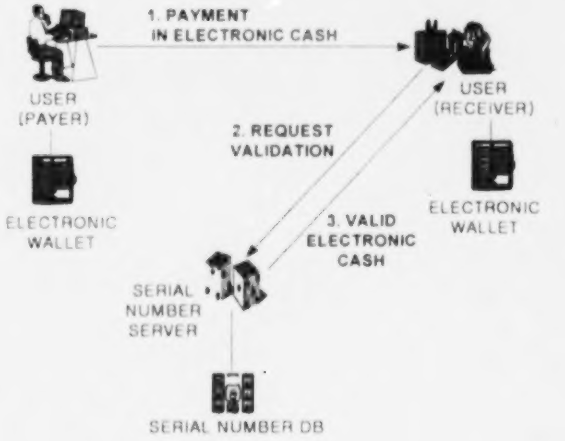

1. PAYMENT IN ELECTRONIC CASH
USER (PAYER)
USER (RECEIVER)
2. REQUEST VALIDATION
ELECTRONIC WALLET
3. VALID ELECTRONIC CASH
ELECTRONIC WALLET
SERIAL NUMBER SERVER
SERIAL NUMBER DB

Figure 4. ELECTRONIC CASH PAYMENT PHASE.

3.2.3 THE DEPOSIT PHASE

Electronic cash is expired when the user deposits it in his/her account. Figure 5 shows the electronic cash deposit phase. When the user wants to exchange electronic cash for physical cash, he/she requests the bank to deposit the electronic cash in his/her account. Then the bank requests the serial number server to validate the electronic cash. After the bank receives the acknowledgment of validity from the serial number server, it deposits the electronic cash in the user's account and sends the acknowledgment of the deposit to the user.

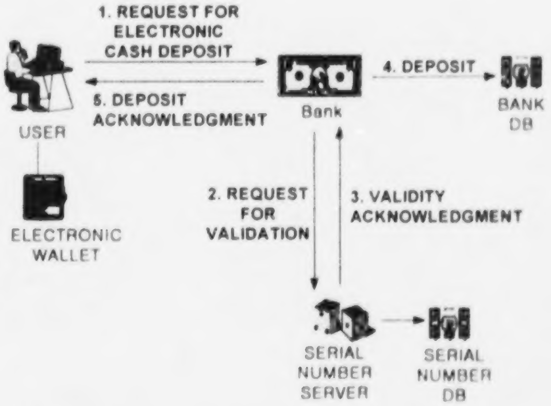

1. REQUEST FOR ELECTRONIC CASH DEPOSIT
4. DEPOSIT
5. DEPOSIT ACKNOWLEDGMENT
USER
Bank
BANK DB
2. REQUEST FOR VALIDATION
3. VALIDITY ACKNOWLEDGMENT
ELECTRONIC WALLET
SERIAL NUMBER SERVER
SERIAL NUMBER DB

Figure 5. ELECTRONIC CASH DEPOSIT PHASE.

4. CONCLUSIONS

As the services using telecommunication technologies have developed, the demand for electronic security and electronic payment systems have increased. In response to such needs, the electronic payment systems providing services such as credit card payment, electronic cash payment are being developed and being applied for use world wide.

We have developed tele-shopping system called TeleSHOP which supports the two secure electronic payment options: the credit card payment system based on the SET protocol and the electronic cash payment system based on the SSNS protocol. The enterprise standard protocol SET encrypts/decrypts a message in the digital envelope which provides reliability as well as rapidity. The SSNS, a protocol proposed by Korea Telecom, provides complete anonymity by separating the serial number management server from the electronic cash withdrawal server. By providing these two payment systems, users can choose the method of payment as they wish. The credit card payment system accepts current credit card members, while the electronic cash payment system allows micropayment and anonymity.

Despite the development of electronic payment technologies, security is not yet fully guaranteed. To make electronic security and payment systems practical, the laws and regulations related to electronic commerce should be established in advance. In fact, such laws and regulations are being established in many countries. For example, the United States is trying to establish the official guidelines covering nine broad issues: customer service, tax, electronic payment system, intellectual property right, privacy, security and encryption, communication infra, inspection, and technology. EC(European Community) is planning to announce the legislation for electronic money and digital signature. Other countries are attempting to establish their own laws and regulations as well.

In the future, the number of tele-shopping users will be increased more and more. Forrester predicts that online direct sales will grow to 4.8 billion dollars in 1998 as a result of the dramatically increasing number of online consumers and sellers[Welz 95]. The prediction can become true only with highly secure electronic payment.

REFERENCES

[CyberCash 97] CyberCash, http://www.cybercash.com.

[Diffie 76] Diffie, W. and Hellman, M., "New Direction in Cryptography," *IEEE Trans. Info. Theory*, Vol. IT-22, No. 6, pp. 644-654, November 1976.

[Ehrsam 78] Ehrsam, W. F., Matyas, S. M., Meyer, C. H. and Tuchman, W. L., "A cryptographic key management scheme for implementing the data encryption standard," *IBM Syst. J.* Vol. 17, No. 2, pp.106-125, 1978.

[Lim 97] Lim, S. Y. and Guen, D. K., "Electronic Commerce Security," *Korea Information Science Society Review*, Vol. 15, No. 4, pp. 45-52, April 1997(In Korean).

[Master 97] MasterCard International, SET 1.0 Officially Launched, http://www.mastercard.com/set, May 1997.

[Mondex 97] Mondex, http://www.mondex.com/mondex.

[Neuman 95] Neuman, B. C. and Medvinsky, G., "Requirements for Network Payment: The NetCheque$_{TM}$ Perspective", *Proceedings of IEEE Compcon'95*, San Francisco, March 1995.

[Paik 96] Paik, E. K., Lee, M. W. and Kim, Y. W., "TeleSHOP: A Multimedia Communication Shopping System," *Multimedia Modeling 96*, pp. 53-68, November 19eun'96.

[Panurach 96] Panurach, P., "Money in Electronic Commerce: Digital Cash, Electronic Fund Transfer, and Ecash," *Communications of the ACM*, Vol. 39, No. 6, pp. 45 - 50, June 1996.

[Park 96] Park, C. S. and Lee, T. K., "Electronic Money Changes the World," *Journal of Korea Institute of Information Security and Cryptology*, Vol. 6, No. 2, pp. 53-70, June 1996(In Korean).

[Rivest 78] Rivest, R. L, Shamir, A. and Adleman, L. M., "A method for obtaining digital signatures and public-key cryptosystems", *Communications of the ACM*, Vol. 21, pp. 120-126, 1978.

[Visa 97] Visa, Electronic Commerce, http://www.visa.com/cgi-bin/vee/sf/standard.html, May 1997.

[Welz 95] Welz, G., "New Deals," *Internet World*, pp. 36 - 42, June 1995.

Trust and Electronic Money across Cultures[1]

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1. ABSTRACT

The new form of Internet money challenges conventional definitions of money, revealing that trust and culture are central to the nature of money. This paper demonstrates that people are more likely to use a form of payment they trust, particularly in situations where the risk of mistrust is the greatest that is, in depositing money; the payment of large sums; in situations where non-payment is likely to result in loss or penalty; and the use of new forms of money. They perceive open networks to be less secure, that is, more prone to theft, fraud and invasion of privacy.

Trust in a particular form of money such as cash, cheques and credit cards is influenced by the historical development of the payments system and by distinctive ritual meanings of cash. The use of Internet money also shapes and is shaped by the boundaries of domestic money. In Anglo-Celtic Australian society, marriage marks the boundary of domestic money. In many Asian societies, it is the family or the household which bounds the domestic financial unit. Hence money is controlled differently and this impacts on the way new forms of money are used.

Factors that engender trust are broader than issues of security. "Hard trust" deals with issues of authenticity, encryption, and security of transactions. "Soft trust" clusters around control, comfort and caring. Providers have concentrated on issues of security which have led to an exploration of technological and regulatory solutions. It is when providers focus on providing control, comfort and caring to the customer, that the use of Internet money increases and the customer moves to the center of a profitable business strategy.

These conclusions are primarily based on a qualitative study of 47 people from 23 households in urban and rural Victoria, Australia.

2. INTRODUCTION

> *"What is REAL?" asked the Rabbit one day ...*
> *"Real isn't how you are made," said the Skin Horse. "It's a thing that happens to you. ...It doesn't happen all at once," said the Skin Horse. "You become. It takes a long time..."*
>
> Williams, Margery. (1995 [1922]). *The Velveteen Rabbit*. New York: Fremont & Green Ltd.

When dealing with Internet money, like the Velveteen Rabbit in the American story, we may well ask, What makes money real? Is plastic money real money? Does typing in a few numbers on the Internet make money real? What makes people trust money?

These are questions that are central to the use of Internet money and the implementation of electronic commerce, for payments is the last activity to go online. In CIRCIT research on electronic money, When we interviewed people for our research on electronic money at CIRCIT[2] people continually distinguished between "real money" such as cash and check and "plastic money" that comes from the credit card or EFTPOS (Electronic Funds Transfer at Point of Sale).

Plastic money, and now Internet money - are exciting new forms of money. Transmitting money over the Internet is such a far-reaching change in the way we live and communicate, that we are faced with the question: What is money? When money is transferred over electronic networks, both open and closed, does the nature of money change or is it only a transformation in the form of money?

The conventional definition of money in economics comprises a list of three basic monetary functions, that is money is a medium of exchange; it is a store of value and a unit of account. What Internet money shows us is that money is sometimes only a transfer of information. This information transaction is seen as money only when it becomes part of a social network of trust. It is a person's use and perception of money that distinguishes money. There is nothing inherent in the plastic card or electronic cash that makes it money. Money transmitted over the Internet only becomes money, when people use it and see it as money. It is trust that makes money real.

This paper is primarily based on qualitative data from 47 open-ended, one-two hour interviews with people in 23 middle-upper-income, mainly Anglo-Celtic households in urban and rural Victoria. The snowball sample was over-representative of people who had PCs and modems, and those who used accounting software. The data were analysed using NUD IST (Non-Numerical Unstructured Data Indexing, Searching and Theorizing), a computer program for qualitative analysis.

3. THE CULTURAL MEANING OF MONEY

Trust is inherently bound up in the cultural meanings of money and the social context of use. These meanings are also related to the historical developments of the payments and banking system in different countries. Much of the understanding of money, however, is based on Western experience. As we enter an age where global markets are possible, and where some of the markets with the greatest growth potential are in Asia, it becomes imperative to study how people in different cultures use money.

Trust is an important focal point, for it links the use of money to a profitable customer relationship for the providers, and to cultural values and meaning for the users. Some of the important questions that need to be addressed in future cross-cultural study of money are: Do people use money in similar ways across culture? How do the differences relate to historical developments of the banking and payments system? What lessons does the cross-cultural study of money have for providers of online services and payments?

3.1 Payments and culture

The cultural meanings of money are most evident in the way people in different cultures use cash. In Anglo-Celtic society in Australia, the United Kingdom and the United States, there is a deep rooted opposition between cash and gifts. Cash is seen as impersonal and tied to the market and therefore seen to be an unsuitable medium for the expression of personal, spontaneous feelings. Cash is only acceptable, if it is transformed into money orders or gift certificates.

In some Asian societies however, cash in a particular form is the only expected gift at a particular occasion. This is true of the *ang-pow* gift at Chinese New Year for younger unmarried girls and boys, where crisp, new currency notes gifted in red packets with appropriate characters and symbols on them. In Malaysia, banks not only distribute the traditional red envelopes for the *ang-pow* but also ensure they have a supply of crisp new notes during Chinese New Year. In Japan, the preference for clean notes has also migrated to the electronic world where some ATMs deodorise and clean the notes before delivering them (Hitachi Ltd. Develops, 1995).

In New Delhi, it is possible now to buy gift envelopes with a rupee coin stuck on the outside so that the *shagan* – the ritual presentation for weddings and births – can be made in auspicious denominations, such as Rs. 11, 21, 51 or 101. The notes are preferably withdrawn from an ATM, as the ATM dispenses new notes (Personal communication A.M.Chaturvedi, Director, Marketing & Development Research Associates, New Delhi, 22 September 1997).

Amongst the Simunul Bajaus of Sabah, Malaysia, cash is the most appropriate gift from most of the guests at a wedding or funeral. Gifts of cash are taken into account when planing the expenditure. This cash is most often presented in envelopes with the giver's name on the outside for purposes of record. Sometimes, the cash is elaborately transformed, as with the payment of bride-price. At one particularly ostentatious wedding in the late 1970s, the MR 3,000 was arranged in the shape of the National Mosque. At another wedding, the money was arranged in floral designs with the red of ten ringgit notes and the green of the fifty ringgit notes being carefully matched (Singh, 1984).

People also use cash, checks and direct debit differently in various societies. The Australian middle and upper-income Anglo-Celtic respondents preferred cash and EFTPOS to credit cards and checks for grocery shopping. In Australia, the check was very much a residual way of paying for groceries, used when the retailer did not have EFTPOS and cash was difficult to obtain because of the lack of bank branches and/or ATMs. It was the rural households who reported regularly using checks to pay for groceries. Credit cards were not preferred because there is a strong Anglo-Celtic cultural norm against buying food on credit.

The use of the check for grocery payments is different in the United States where groceries are paid primarily by check (37%), followed by debit cards (26%), cash (25%) and credit cards (12%) (Lipis and Hodgdon, 1996). The greater use of the check is not confined to grocery payments alone. An average of 237 checks were written per head in the United States in 1994, compared to 55 checks per head in Australia (Mackrell, 1996).

This comfort with checks is not universal, for checks are acceptable only between known persons in countries such as Malaysia and India. In Malaysia, for instance, many of the recent payments initiatives have been geared towards making the check a more trustworthy instrument (Singh, 1995).

Australians' minimal use of direct debit is in strong contrast to the European preference for GIRO payments. The GIRO system is a mandate for periodic direct debit payment. According to Chris de Smet (1996), President, AT&T services, AT&T Europe, Africa and Middle East, Belgium, in Europe the GIRO system works within the context of a banking system where there is a stable and long-standing relationship between customers and their bankers. The check account is central to this relationship. Typically, banks automatically offer two to three times the monthly salary as an overdraft at rates indexed to prime lending rates, plus three percent, thus eliminating the need for revolving credit.

In Europe, the GIRO payment also yields greater information, in that a statement is issued to the customer after each GIRO payment. If there is a problem the money goes back to the customer without question. Thus, the customer retains greater control over the information and the transaction. Unlike Australia and the US, in many European countries electronic payment processing is the norm. The problem for providers is in harmonising national GIRO systems with regional networks, rather than seeking a behaviour change among their customers.

3.2 Domestic Money and Culture

Some of the most distinctive cultural differences lie in the boundaries of domestic money (Singh, 1997). These cultural differences need to be taken into account when assessing the use and impact of Internet money for they relate to the way money is managed and controlled in the home.

In middle-income Anglo-Celtic society, the marital unit is the primary domestic financial unit. Marriage money, that is money in marriage is the most important kind of domestic money. Its boundaries are marked most visibly by the marital joint account and joint marital home ownership. Roughly three-fourths of married couples in Australia have a joint account. There is little flow of money outside the marital unit to grown up children or parents. This pattern exists within the safety net of the old age pension, which ensures a minimum survival income. Parents also take pride in their ability to manage on their own, without having to call on their children for financial help.

The boundaries of marriage money in middle-income Anglo-Celtic Australia are also marked by an intense privacy about domestic money. There is little discussion of money between parents and adult children, and even less between siblings and friends. It is as if the privacy of money draws a circle around the couple.

In many Asian cultures, it is the family or household unit rather than marriage, which is the more pertinent boundary of domestic money. This is often related to the ideological dominance of the discourse of the family rather than marriage. In India, the Hindu Undivided Family is a legal construct which is officially recognised as a financial unit for tax purposes. This emphasis on the family is accompanied by the lack of clear and enforceable rights of the woman to marital property during marriage, divorce or widowhood. It is important to recognise that the 'separate pot' system of money management is more common in the world than the 'common purse'. This is especially true where polygamy is prevalent and/or marriages are unstable (Blumberg, 1991: 122).

The ideological emphasis on the family supported by a code of filial care also encourages a flow of money from children to parents. Stivens (1987) describes how the flow of money in Negri Sembilan in Malaysia is from single and married children to parents. Parents and older kin reciprocate through help with child care. This flow of money and care is supported by the moral code that kin should help each other and by the matrilineal ideology making for female solidarity. This notion of kin helping each other is also promoted by the state as being a virtue of the Asian family, while filling the gap left by a rudimentary welfare system.

Money in many cultures is also not necessarily private to a married couple. Ram's (1991) study of the Mukuvvar women in a fishing community in South India describes how information about loans and debts is shared among the women's close relatives. This was because the network of credit cemented kinship and neighbourhood ties.

4. TRUST AND THE USE OF ELECTRONIC MONEY

People are more likely to use a form of payment they trust. Trust, however, does not ensure use. A person may trust cash and checks but may not pay everything by cash or checks.

It takes a long time to engender trust in a new form of money. Australians are known to adopt new technologies easily. However, Reserve Bank of Australia data show that in 1995

- In 1995 payment by credit and debit cards comprised only 0.2 percent of cashless transactions in value, and 25.8 percent by volume. ATM transactions are not included as they are not payment transactions (Unpublished data from the Reserve Bank of Australia, 1997).
- Cash remains the most convenient and popular form of payment for everyday, low-value transactions and

could possibly account for as much as 90 percent of these transactions (Australian Payments System Council, 1995).

- The check is the most popular form of non-cash payment in Australia. In 1995, its volume (38 percent) exceeded that of credit cards (10 percent), EFTPOS (13 percent), ATM (17 percent), direct entry credit (18 percent) and direct entry debit (4 percent) (Mackrell 1996).

- Although high-value electronic funds transfer is now for the first time higher in value (63 percent) than checks (35 percent), checks continue to dominate over retail low value electronic funds transfer which remained unchanged between 1991 and 1995 at 2 percent (Mackrell 1996).

- Australia ranked seventh in the number of inhabitants per ATM and EFTPOS outlet in 1995, among the 12 major developed countries monitored by the Bank for International Payments (Commonwealth of Australia, 1997). However, around 45 percent of Australian consumers have never used EFTPOS, and approximately 35 percent have never used an ATM (Asher, 1997).

4.1 Defining Trust

Though trust is at the very center of the definition and use of money, trust is difficult to define because it is nebulous and all pervading. People speak of trust in terms of *comfort*, *certainty*, being *more confident and in control*, *faith* and *reliability*. They also speak of trust in terms of *security* and related aspects such as *fraud*, *theft* and *privacy*.

People speak of trust and money most clearly when they are speaking of a lack of trust. They speak of trust in relation to payments particularly in contexts where the risk of loss is greatest and where the information is less easily available, ie. in depositing rather than withdrawing; paying large sums as against small sums; in situations where non-payment is going to result in loss or penalty; paying with new forms of electronic money; and payment over open rather than closed networks.

Although many people in Australia trust the ATM enough to withdraw money, only one or two percent of deposits are made through ATMs. In the United States, even with the new generation ATMs, the figure is said to be five percent (Allard, 1996).

The risk of loss appears greater as payments move from traditional forms to new forms, and from closed networks to open networks. The difference between electronic commerce over the Internet and previous electronic payments such as ATMs, EFTPOS and credit cards, is that previous electronic payments went over closed systems rather than the open and public networks.[3] People speak of the risk of theft or fraud as almost wholly to do with the risk that hackers will access one's credit card numbers on open networks. The Internet features more often than the phone and the fax, as on the Internet "anybody" can have access to data or money.

It is important to stress that people interviewed were talking about their *perception of security* rather than a technical evaluation of security. Consumer trust in the security of a system is often built on ignorance of the potential of fraud or level of actual fraud. The value of consumer ignorance is appreciated by financial institutions and credit card companies. These organisations bear the loss of credit card fraud in silence, preferring it to disclosure and the ensuing lack of trust in the system. This is not possible over the Internet, where the activities of hackers and cases of fraud are broadcast over the Net and soon make the news in other media.

Concerns of security spill over into concerns for privacy. Privacy is spoken of in terms of harassment, surveillance, tampering/destruction of data and fraud. The possibility of accessing credit card numbers is seen as an invasion of privacy and a breakdown in security. What is noticeable is that the privacy fears were expressed in response to direct questions from the interviewer, rather than raised spontaneously. Consumers' concerns about privacy were prompted by a knowledge of the possibilities of technologies yielding more transaction generated information leading to companies and the government putting together details about one's personal life.

Nobody talked of trusting or not trusting the traditional physical forms of money, such as cash or check over the counter, other than to contrast them with electronic forms of money. Cash and checks are taken for granted and have a measure of comfort and experience behind them in modern Anglo-Celtic society in Australia.

5. ENGENDERING TRUST

An important question for providers is: How is trust engendered in electronic money and the online environment? In answering this question, it is useful to distinguish between trust and security and between interpersonal trust and system trust.

Trust encompasses issues wider than security. The discussion of the Aspen Forum on Electronic Commerce is helpful in distinguishing between security and trust, particularly in relation to electronic commerce. David Bollier reporting on the discussion, notes:

> It may be conceptually useful to distinguish between issues of "hard trust," which involve authenticity, encryption, and security in transactions, and issues of "soft trust," which involve human psychology, brand loyalty, and user-friendliness... It is important to see that the problems of engendering trust are not simply technical in nature.... Trust is also a matter of making psychological, sociological, and institutional adjustments (1996, p 21).

Interview data and the literature on trust show the criteria that engender "soft trust" in physical and electronic forms of money, fall into three clusters, control, comfort, and caring. The difference between control, comfort, and caring is conceptual. In practice, the distinctions between them are hazy. In all three clusters, the quality of information is central. Providers of services have seen transaction information generated and stored by online systems as a valuable key to predicting consumer behaviour and determining marketing strategies. Users of electronic money are more interested in how they can use online systems to have greater control and comfort with the flow and management of their own money.

In order to understand how trust is engendered in electronic money, it is also important to note the difference between interpersonal trust and system trust. The difference between interpersonal trust and system trust is like the difference between trusting your spouse with money in marriage and having trust and confidence in the payments system. With interpersonal trust, there is trust in a person, whereas trust in money in the market context is trust in a symbolic representation of exchange value.

System trust needs to be further distinguished as trust in physical systems and trust in online systems. With electronic money, we are dealing with interactive online systems. However, much of the discussion in the literature around trust deals with building trust in a physical, interpersonal environment. As Samarajiva (in press) notes, "Little is known about how to create a trust-conducive environment based on interactive media systems" (p 11).

In both interpersonal and system trust, at some level, trust means an absence of questions and a willingness to accept certain things on faith. Regulators of the payments and banking systems aim to create a system that is stable and secure, so that there is no question as to whether or not people trust a bank or a currency. When questions arise about the safety of money in a bank or about the value of a particular currency, trust has already been shaken.

Electronic money does not offer the comfort of the physical payments instrument and the face-to-face transaction. Neither does it have as long a history of use and familiarity. Trust, however, may be built on specific qualities of the online environment such as speed, instantaneous communication, personalisation of information, and tracking procedures. As Samarajiva says, one of the challenges of engendering trust in online money is to "make the proper links between interpersonal trust, that most people can relate to easily... and system trust" (Personal Communication, 14 March 1997).

5.1 Control

Information is the key factor for the use and control of money. As with trust, people speak most vividly of control when they experience a lack of control. Our data show the customer feels in control of money when there is:

- A physical payments instrument and/or record of payment;
- A clear identification of the person at the other end of the transaction;
- An ability to track and substantiate a transaction;
- Information to help manage and control the flow of money; and
- The option to determine his or her desired level of privacy.

There is a deep rooted sense of money as something tangible and physical. Cash remains the reference point for the way people talk about money. It is common for people to say they have no money when they mean they have no cash. The metaphor of money as something physical is repeated in phrases such as "heaps of money", "handling" money, of "actual money in hand", not "touching" savings (Singh, 1997).

Not only is physical money seen to be more "real" and tangible but the information about physical forms of money is more controlled by the customer. The paper receipt is proof of having paid, and this proof is with the customer rather than dependent on the reliability of computer records, or archived within a corporation's system. The lack of a paper trail is seen as one of the greatest disadvantages of direct debit in Australia.

The personal transaction involves immediate verification. Much of the comfort with personal transaction modes such as the branch, the post-office, lies in the customer being able to identify that a particular person or a representative of an organisation, received the payment. The ATM is not trusted for depositing money because there is no immediate, personal verification of the transaction.

The popularity of the post office in paying for bills also has its root in the personal element of the over-the-counter transaction. Australia Post claims to be Australia's "biggest over-the-counter electronic bill paying and agency banking service, handling more than 150 million transactions each year" (Australian Payments System Council, 1996).

5.2 *Comfort*

Comfort and reassurance about future outcomes strengthens trust and is at the center of the relationship between customers and providers. The consumer feels comfortable about the future when there is routine, familiarity and previous experience; reputation and predicability; trusted facilitators; a capping of liability; and/or certification and warranting structures. The qualitative data show that residential customers feel comfortable with forms of money when some of the following conditions are fulfilled:

- They have previously had a positive experience using a form of money;
- They know of the service provider and/or the person or firm receiving the payments;
- A new form of money has been introduced to them by trusted facilitators in a safe environment;
- The risk of loss is minimised, capped and known;
- Warranting structures are in place to vouch for the quality of the goods and services.

It is because of these factors that the traditional forms of money - that is paying by cash or check over the counter - elicit so little mistrust. The older forms of electronic money, such as credit cards, the ATMs and EFTPOS also have had one to two decades to establish familiarity and comfort.

A bad experience with any form of money will jeopardise a person's trust in its future use. The person may become wary of or may totally avoid the particular form of money.

Trust can take a long time to build and may need a variety of "warranting structures" to vouch for the reliability of payments mechanisms. There was little in the interview data about warranting structures, partly because there are presently few such mechanisms in place for electronic money. Trust in the older payments instruments and transaction modes is closely linked to trust in the regulation of financial institutions and the monitoring of the payments system. It is so well established that there is little discussion of it by consumers when talking of their payments choices.

At the providers' level, there are initiatives such as the eTrust programme which attempt to set up a logo system of "Trustmarks" that would assure consumers that the providers are following acceptable privacy guidelines (The eTrust story, 1996). Visa and Mastercard have established agreed standards for secure electronic transactions. The setting up of certification authorities to ensure cryptography and digital signatures is also an essential part of the warranting exercise.

The discussions around liability and dispute resolution find a more immediate resonance in consumer concerns. In Australia, liability of credit cards over the Internet remains a grey area. and has not been tested in the courts as yet. The issue is one which is being considered by various government bodies. It is interesting to note that the five people in our sample who had paid by credit or debit card on the Internet believed that their liability was capped at $A50 in accordance with the Electronic Funds Transfer Code or their credit card guidelines.

5.3 *Caring and Communication*

A constant thread in the literature on trust is that certification and technical expertise is often *not enough* to ensure trustworthiness. Trust is strengthened if the customer feels that the provider of goods and services not only cares for his or her business at the point of transaction, but continues to support the customer with care and service after the sale.

The importance of benevolence, intimacy and communication in engendering trust was articulated by the respondents, particularly when it was marked by its absence, as with Australian banks.

6. PROVIDERS' STRATEGY FOR TRUST

There is no doubt about the importance of trust in business relationships. Trust is the non-contractual element of contract. It is an important component of exchange transactions.[4] Trust reduces transaction costs (The eTrust story, 1996; Fukuyama 1995).

Trust is at the center of relationship marketing, where the emphasis is on establishing, relationships. maintaining and enhancing relationships with customers so that the service providers can achieve a profit and the customers receive value (Gronroos, 1996). Reichheld (1993) presents convincing evidence that companies that are based on loyalty increase their profits through customers' repeat purchases and referrals, decreasing transaction costs and costs of acquiring customers, and increased employee retention - which further increases customer loyalty and decreases staff hiring and training costs.

Trust in interpersonal and business relations is also strengthened by indications of commitment to the same goals. Handy (1995) who discusses trust in a virtual organisation, argues that this kind of bonding is manifest in some companies' mission statements, campaigns for total quality or excellence, and personal example by leaders. Employees can be thought of as members of a large family business, each of whom has clear responsibilities and expected outcomes but for whom there is a sense of belonging and collective pride.

It is Fukuyama's (1995) thesis, that trust is important not only for individual business relationships, but trust is central to the creation of large commercial organisations countries where people have a high degree of trust in groups and networks beyond their family.

6.1 Providers have Focused on Security rather than Trust

Providers of electronic money and commerce acknowledge the value of trust and consumer confidence. They have however concentrated on issues of security rather than trust, on "hard trust" rather than "soft trust".[5] This preoccupation with security issues has led to an exploration of technological and regulatory solutions - the importance of different encryption systems; the investigation of private and public keys; digital signatures; ways of combating fraud, counterfeit and money laundering; checking the invasion of privacy; issues of international law and liability; and the creation of authentication and certification structures.

The emphasis on security is partly fuelled by the assumption that people would buy more goods and services online if electronic payments were more secure. However many of the security concerns are being driven by providers' need for security.

A complementary emphasis on the broader issues of use and "soft trust" leads providers of electronic money and commerce to also ask:

- What can I do to increase access?
- Does the payments transaction offer information appropriate to the activity and cultural meaning?
- Have I given control of information and the transaction to the customer?
- Have I increased the customer's feeling of comfort with the transaction?
- Have I shown the customer I care?

The weight placed on each question will change according to the activities, kinds of transactions and the social and cultural context.

6.2 A Strategy Emphasizing a Profitable Customer Relationship

An emphasis on trust means a larger cultural change for providers, for engendering trust goes beyond a check list of solutions. As Reichheld (1993) says, "Building a highly loyal customer base cannot be done as an add-on. It must be integral to a company's basic business strategy" (p 64). The strategy places the customer at the center, aiming for a profitable customer relationship rather than concentrating solely on the cost of single transactions. It moves from *transaction marketing* to *relationship marketing* (Gronroos, 1996).

A customer focused strategy is particularly necessary for providers of electronic commerce as the customer can access increasingly customised goods and services from a multiplicity of suppliers across traditional market and cultural boundaries. This customer centered strategy is also essential because using only the providers' perspective has failed to predict customers' use of forms of money.

The most glaring failure has been the prediction that electronic payments would become the dominant payments mechanisms. Data from the United States show that in the past 20 years, check transaction volume has increased more than all electronic services combined (Lipis, 1997). These data are in tandem with that presented by Daruvala and Stephenson (1996) who show that in 1995 electronic payments - ie. credit and debit cards, direct entry and EFTPOS - comprised only three percent of the number of payments transactions and 23 percent in terms of value.

Adopting a customer centered strategy goes beyond adding another check list of questions to consider. It involves a cultural change and learning a different language which focuses on the use rather than the provision of online services. Many of the metaphors used by providers of electronic money and electronic commerce are from engineering and economics. Hence the talk of "tool kits", "drivers", "applications" on the one hand and emphasis of "demand", "price", "determinants" and "take-up" on the other. Providers who are used to speaking in terms of the "roll-out" of technologies, are telling a story where technology provides the solutions to modern problems.

The language used when starting from the users' perspective is drawn more from anthropology and sociology. The discussions center on the process of "constructing meaning" the "mix and match" and the "fit" of technologies and applications to the way people conduct a range of activities.

These metaphors dictate business strategy and influence the kind of data collected. As cash transactions are difficult to measure, most often these transactions are missing from provider dominated descriptions of payments systems. Since purchase is easier to measure than access and usage, the emphasis is on purchase.

With an emphasis on technology and measurement, comes a way of seeing the world where the relationship between different factors is linear and is depicted by value chains, rather than by understanding a multidimensional process, whereby customers mix and match new and old technologies to fit with their activities and social and cultural frameworks.

An important aspect of the change in metaphors is the recognition of the interrelatedness of the economy, social relations and cultural values. Using different forms of money is not just a matter of cost and convenience. It is ensuring that money with the appropriate cultural meanings is used for various activities. Electronic forms of money are not only changing the nature and cost of distribution networks, they are also changing the way people access, manage and control money at home and at work.

NOTES

[1] I would like to acknowledge the valuable help of Claudia Slegers of CIRCIT in helping with the coding and analysis of the qualitative data. She coauthored an earlier paper on Trust and Electronic Money on which part of this paper is based. The earlier paper was greatly improved as a result of the comments of David Bollier, John Burke, Mari Davis, A. Lee Gilbert, Rémi Guibert, John C. B LeGates, Evelyn Richardson, Rohan Samarajiva and Peter White.

[2] See Singh, S. (1996). *The use of electronic money in the home.* Policy Research Paper No. 41. Melbourne: Centre for International Research on Communication and Information Technologies; Singh, S and Slegers, C.. (1997). *Trust and electronic money.* Policy Research Paper No. 42. Melbourne: Centre for International Research on Communication and Information Technologies; and Singh, S. (1997). *Marriage money: The social shaping of money in marriage and banking.* Sydney: Allen & Unwin.

[3] 'Open' or 'public' networks such as the public switched and mobile telephone networks, exhibit 'any-to any-connectivity. Parties utilising these networks for business (or private) purposes are generally not well identified, or known in advance to one another. Therefore trust, security and confidentiality are far less predictable or controllable. 'Closed' systems or networks, such as ATMs and EFTPOS, have always been carried over telecommunications systems which service only the business parties involved (Vaughan, Sewards and Kelso, 1997). Rohan Samarajiva clarifies the distinction further saying that there is a distinct difference in perception. It must be noted however that technically, some portions of "closed systems" traverse open or public networks. These technical separations can be pierced with consequent security implications (Personal communication, 14 March 1997).

[4] See Arrow 1975; Granovetter 1985, Semmes 1991; Sterling 1995;

[5] An Internet search for "security" and for "trust" and its synonyms "confidence", "reliability", "faith", "safety" and "comfort" in the broad areas of "electronic commerce", "smart card", "e-cash" and "digital cash" on 20 February 1997 showed that the emphasis on security far outweighed that on trust. For instance, an Altavista search of electronic commerce brought up 80,000 hits. Of these, 5,000 had "electronic commerce near security" with only 162 coming up for "electronic commerce near trust". Of the 821 articles dealing with electronic commerce in the ABI Inform business catalogue, September 1995 to August 1996, 184 mentioned "security" and only eight mentioned "trust".

REFERENCES

Allard, T. (1996, 11 May). We're withdrawn on ATM deposits. *The Sydney Morning Herald.* p. 3.

Arrow, K. (1974). *The Limits of Organization.* New York and London: W.W. Norton and Co.

Asher, A. (1997, 21 April). A *more competitive national market? The ACCC view.* Paper presented at the conference Competing in local and international banking markets: The post-Wallis outlook, The Regent Hotel, Sydney.

Australian Payments System Council. (1995). *Annual Report 1994/95.* Sydney.

Australian Payments System Council. (1996, 16 February). *Giropost information paper.* Paper tabled at the meeting of the Australian Payments System Council, Sydney.

Blumberg, Rae L. 1991. 'Income under Female versus Male Control: Hypotheses from a Theory of Gender Stratification and Data from the Third World', in R. L. Blumberg (ed.), *Gender, Family, and Economy: The Triple Overlap*. pp. 97-127. Newbury Park, Calif.: Sage Publications.

Bollier, D. (1996). The future of electronic commerce: A report of the Fourth Annual Aspen Institute Roundtable on Information Technology. Aspen, Colorado: The Aspen Institute.

Commonwealth of Australia. (1997). *Financial System Inquiry: Final Report*. Canberra: Australian Government Publishing Service.

Daruvala, T., and Stephenson, J. (1996, 8-9 October). *From atoms to bits: managing an industry in transition*. Presentation at the Bank Administration Institute's National Payments System Symposium, Washington.

de Smet, C. (1996, 8-9 October). *Lessons from abroad. Innovative strategic responses*. Presentation at the Bank Administration Institute's National Payments System Symposium, Washington.

The eTrust story (1996) http://www.eTRUST.org

Fukuyama, F. (1995). *Trust: The social virtues and the creation of prosperity*. London: Penguin.

Granovetter, M. (1992). Economic action and social structure: The problem of embeddedness in Mark Granovetter and Richard Swedberg (Eds.), *The sociology of economic life*, pp. 53-81. Boulder: Westview Press.

Gronroos, C. (1996). *From marketing mix to relationship marketing: towards a paradigm shift in marketing*. Key-note paper presented at the First WWW Conference on Relationship Marketing.

Hitachi Ltd. develops ATM technology that "cleans" money. (1995). *The World of Banking*. August-September.

Lipis, A.H. (1997, March/April). Electronics held in check, *Banking Strategies*.

Lipis, A.H., and Hodgdon, R.F. (1996, 8-9 October). *Customer perspectives on payments system*. BAI National Payments System Symposium, Washington DC.

Mackrell, N. (1996, October). Cheques and the payments system. *Reserve Bank of Australia Bulletin*. pp. 26-31.

Ram, Kalpana. 1991. *Mukkuvar Women: Gender, Hegemoney and Capitalistic Transformation in a South Indian Fishing Community*. Sydney: Allen and Unwin.

Reichheld, F.F. (1993, March-April). Loyalty-based management, *Harvard Business Review*. pp. 64-73.

Samarajiva, R. (in press) Interactivity as though privacy mattered. In *technology and privacy: The new landscape* edited by Phil Agre and Marc Rotenberg. Cambridge MA: MIT Press. (Citing from manuscript revised June 1996).

Semmes, C. E. (1991). Developing trust: patient-practitioner encounters in natural health care. *Journal of Contemporary Ethnography*, 19(4):450-470.

Singh, S. (1984). *On the Sulu Sea*. Kuala Lumpur: Angsana Publications.

Singh, S. (1995). *Money online in Malaysia*. CIRCIT Working Paper 1995/3. Melbourne: Centre for International Research on Communication and Information Technologies.

Singh, S. (1996). *The use of electronic money in the home*. Policy Research Paper No. 40. Melbourne: Centre for International Research on Communication and Information Technologies.

Singh, S. (1997) *Marriage money: The social shaping of money in marriage and banking*. St. Leonards, NSW: Allen & Unwin.

Singh, S., and Slegers, C. (1997). *Trust and electronic money*. Policy Research Paper No. 42. Melbourne: Centre for International Research on Communication and Information Technologies.

Sterling, L. (1995). Partners: The social organisation of rotating savings and credit societies among exiled Jamaicans, *Sociology* 29(4):653-666.

Stivens, M. 1987. 'Industrialisation: The Case of Rembau, Negeri Sembilan, Malaysia'. In H. Afshar (ed.), *Women, State & Ideology: Studies from Africa and Asia*. pp. 89-110, London: Macmillan.

Vaughan, J., Sewards, T., & Kelso, R. (1997) *Study of the law of internet commercial transactions*. Melbourne: Centre for International Research on Communication and Information Technologies.

Williams, Margery. (1995 [1922]). *The Velveteen Rabbit*. New York: Fremont & Green Ltd.

A Blueprint for Electronic Government

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A local government IT masterplan sets out a viable strategic direction for the use of information technology (I.T.) to support local government operations, align the use of I.T. to that of the nation, and build the organizational capacity necessary to take maximum advantage of the rapid emergence of more advanced tools in the future. Its purpose is to guide the deployment of I.T. as a tool to transform local government operations, in three domains:

1. *Within and among the various agencies of the local government*
2. *Among these agencies and organizations in the private sector*
3. *Among these agencies and members of the general public*

This paper, based on research conducted for a local government located in a geographically remote area in Southeast Asia, lays out a basic structure, process, and content for such a plan. It is intended to serve as a template for use by other jurisdictions in a similar context.

Introduction

Like any tool, a planning process must fit its context. This includes geographic, political, social and economic environment, the organizational structure, and its scale, scope, culture, policies, core technology, and access to IT and other resources. The scope for IT planning includes selecting computing and communications hardware and software, structuring and staffing IT service delivery, specifying IT-based applications and data resources serving the host agency, and the design of products or services based on information delivered via its IT infrastructure.

The case site is a state government in Malaysia. This specific context is uniquely interesting because of its remoteness, relatively small population, strong interest in IT-based solutions among government leaders, and emerging national policies that will support and enhance local efforts.

The Vision

The plan is informed by its policy vision, to achieve administrative renewal and bring the Government closer to its citizens through a fully electronic government by the year 2002. This "electronic government" model expressed by local leaders reveals the desired features of radically new processes, enabled by deploying new capabilities resulting from the continuing convergence of computing and telecommunications technologies, and by the rapid diffusion of these technologies to the general public:

Figure 1:
Summing up Electronic Government

Technological Performance Vision	**+**	**Organizational Performance Vision**
• ***Reliability***		• ***Service Linkages***
• ***Security***		• ***Legal Framework***
• ***Speed***		• ***Collaboration***
• ***Access***		• ***Manpower***

Reliability: The information infrastructure, data, applications, and operational arrangements must be reliable and accurate.

Security: The government must be able to guarantee that confidential data held in the system by internal and external users performing transactions is fully protected.

Speed- the network and hubs must be sufficiently powerful to support the required number of transactions, and links to other hubs must also be efficient.

Access- Electronic government infrastructure must provide connectivity that will support an "anytime, anywhere" service delivery model, with multiple ("anyhow") access modes to ensure that citizens on the periphery have equal access to those nearer the centre.

Service Linkages- as many transactions and interactions involve multiple parties, the system must provide links to other services needed for direct payment. For example, utility payments involve banks, which must be included for completeness.

Legal and Procedural Framework- local legislation, administrative regulations, and procedures to align IT use with the realities of governance and service delivery in a new technological context. The local framework must be harmonized with changes emanating from national initiatives, and with the international legal order emerging from the rapid diffusion of electronic commerce.

Collaboration: Electronic government is not viable in isolation. To succeed, the local agency must establish solid links with the MSC, Singapore, and technology suppliers.

Manpower: Across local agencies and within the private sector, specific skills will be required to design, implement, and operate the infrastructure and applications needed to realize the electronic government vision.

The Strategic Direction

Strategic IT direction is expressed through the pragmatic and concrete acquisition and deployment of resources that will support the vision expressed by leaders. These decisions and actions emerge from an analysis of the vision in the context of an intensive environmental scan (*to identify external opportunities and threats resulting from changes in the environment*) and a realistic internal scrutiny (*to identify potential strengths and weaknesses*).

Shifting Environmental Forces

The environmental scan diagnoses the impact of structural forces on the future of the organization. For local government, the significant environmental forces stem from shifts in the global economy, introduction of new technology and rapid development of the nation and of its people. Current technological trends include:

1. *The adoption of cross-platform browsers and platform-independent languages as common interfaces.*
2. *The emergence of low cost digital "appliances" for network access, which will be widely used in homes.*
3. *Rapid increases in bandwidth from heavy investments in networks, combined with improved efficiency through data compression and other technological advances.*
4. *Improved data management tools, such as data warehousing.*

History shows that new technology leads to change in other domains.

Technology's Social and Industrial Impact

After Alexander Graham Bell invented the telephone in 1876, factories could be linked to markets. Three years later, Thomas Edison invented the electric light, and factories could extend their hours. As the railroads spread, these inventions soon altered the American economic structure. Migration from farm to factory and immigration from abroad created a new labor force to drive economic growth and position the US as a new world power.

Similarly, the technological innovations outlined above will inevitably lead to:

1. *Exponential growth in content as access to the medium expands*
2. *A new global and local industry structure, as the business model evolves and weaker players exit.*

Links to National Policy

The Malaysian government embarked on a policy to bring its people into the ranks of the developed world by the year 2020, less than a quarter-century from now. Within this broad initiative, it recently formulated plans for a Multimedia Super Corridor (MSC), to support the Prime Minister's vision of an Information-Rich Society. This will demand not only development and effective use of IT, but an acculturation process that enables citizens to participate meaningfully in this transformation to a knowledge-based society.

> "Information-Rich Society: "one which thrives and grows in all its activities through the ready and dynamic utilization of information, brought about by its active appreciation, acquisition, assimilation, application, and transmission."
>
> *Malaysian Prime Minister*
> *Dr. Mahathir bin Mohamad*

The resource elements of the IT 2020 vision include building the national capacity to produce and manage IT resources, developing sufficient manpower with the right skills and knowledge to put these resources to use, developing telecommunications and data services infrastructure and industries to provide connectivity at the national and international levels, continuing development of the local computer industry, and especially of the small and medium scale support industries on which the computer and telecommunications industries depend.

The Multimedia Super Corridor (MSC) project involves attracting and nurturing a cluster of enterprises to peninsular Malaysia, which will develop several flagship applications which embody its diverse thrusts, including: Telemedicine, Smart Schools, Multimedia Funds Haven, Multimedia

Research and Development Cluster, Electronic Government, Worldwide Manufacturing Web, and Borderless Marketing Centre.

While all these application areas are relevant, the MSC Electronic Government element is a strategic opportunity to link local government efforts to the larger and technically deeper MSC initiative. Its main thrusts are to:

- ***Offer efficient, high-quality administrative services to citizens and businesses,***
- ***Streamline internal government processes to improve service quality and reduce costs,***
- ***Strengthen data security while protecting privacy,* and**
- ***Strengthen democracy* [2].**

An MSC Implementation Task Force, guided by a fully empowered Steering Committee, will oversee the fast-track development of four or five strategic "mini-flagship" applications, such as on-line services for citizens and businesses, EDI-based public procurement, and multipurpose smart-cards to facilitate access to government services. The success of this initiative is seen by its sponsors to depend on strong and continuous leadership across ministries, joint public and private funding, extensive investments in training and change management, and a willingness to re-engineer government processes where necessary [3].

By the year 2000, the government expects specific ministries (including the Prime Minister's Office) to operate fully electronically, mainly through the use of advanced Intranet technology. This requires formulating and enacting new legislation to protect security and privacy, and establishing government-wide standards enabling cross-ministry use of selected mission-critical infrastructure components and databases.

The Strategic Role of Culture

What governments do forms the context for what IT can do for government. Electronic government is not about being more efficient, or using exciting new technologies or even moving existing systems from a national to a local level. It's about defining government functions first and then building new systems around them to support a truly distributed "Third Wave," model that, as the Tofflers suggest, departs from Industrial Age models. In their view, customization is replacing standardization; complexity with its holistic view is replacing the specialization practice of breaking down tasks into component parts; just-in-time production is replacing synchronization; flat organization charts are replacing hierarchy; decentralization is replacing centralization. IT is the enabling technology for all these strategic shifts.

Today's government institutions were designed to support an industrialized society. The challenge today is the transition from an industrialized model of government -- centralized, hierarchical, and operating in a physical economy -- to a new model of governance, adaptive to a virtual, global, knowledge-based, digital economy, and to fundamental shifts in social structure.

"The government we see in the US today has a particular decomposition at the federal, agency and department level that was based upon understandings of what problems looked like one hundred years ago. Those structures were designed to absorb complexity and make things governable. They don't matter in the same ways that they did; and explain why there is such a call for reengineering. These older structures are not working in the US or in a lot of other places we explored. The world is very different now. [4]"

Strategic Analysis

The key policy objectives are to improve public service levels and to create an environment that attracts investment, which would then create new and better jobs for residents and generate wealth. The viability factors include [1] rapid introduction of relevant new technologies, [2] the availability of specific skills and interests in using this technology, [3] the recent emergence of a small but active local market for technology (which supports local vendors and attracts overseas technology sources), and [4] the potential availability of a vast amount of useful content.

Strengths

Over the near term, the primary strengths are [1] leadership who strongly support the strategic goals of administrative renewal and bringing the government closer to its citizens; [2] access to the necessary financial resources; and [3] key "islands of competence" in various disciplines (such as current knowledge of institutional systems and recent local initiatives in electronic publishing) that will be critical to successful deployment of the new media.

Weaknesses

These are: [1] an inadequate public and local government telecommunications network infrastructure; [2] information technology architecture too weak to enable the necessary level of connectivity and data sharing; [3] a lack of data administration, [4] scarcity of skilled manpower resources, both technical and managerial, needed to build, operate, and manage a state-of-the-art IT infrastructure and the electronically enabled business processes that will enable direct delivery of government services, and [5] very little service quality management experience.

Strategic Opportunities

- ***Sharing Data and knowledge***
- ***Coordinated agency efforts***
- ***Motivated workforce***
- ***Well-informed public***
- ***Responsive, high-quality service***
- ***Successful local firms***
- ***Willing overseas investors***

Online Publishing & Broadcasting

Television, print and radio share the basic characteristics of broadcast media. Messages are one-way, distributed indiscriminately to a wide audience. In contrast, the Internet is a two-way communication medium. And, the "audience" is an individual user either searching out sources directly for specific information or engaging with communities of common interest. Whereas the broadcast media is highly regulated with gatekeepers, on the Internet, anyone can be a publisher or broadcaster. The broadcast media acts as a filter, choosing what material will be broadcast within regulatory boundaries. On the Internet, a web site provides a direct two-way link to its particular constituency, whether it's stamp collecting or retail sales from a "mom and pop" boutique.

> "The Net changes the way we distribute information in a fundamental way that makes it highly participatory. One of the characteristics that's so important is that distribution costs fall almost to zero. For example, I put up the Center for Democracy and Technology web site and for a very low cost was in communication with potentially 40 million people out on the web. I didn't have to get a story in the Washington Post about the new organization. I could go directly to that constituency." [5]

Threats

Most threats to the proposed strategy are internal in nature, and are linked to the extent to which early systems produce visible benefits. The primary hazards include a lack of sound technology management, poor top management support leading to inadequate funding, poor security leading to low public confidence, and lapses in service quality management.

Functional Strategies and Actions

1. ***BALANCE technology, organization, resources***
2. ***UTILIZE Local government.net as basis for strategic linkages***
3. ***INVEST in IT manpower: technical & managerial***
4. ***LEVERAGE available resources, public & private***
5. ***DEPLOY a broad range of IT-based solutions, adapt service processes to maximize benefit***
6. ***STRUCTURE supply to meet demand, create demand to use supply of IT resources***

These six "BUILDS" strategies represent the major initiatives for action. However, harmony follows only when each individual action programme conforms to all six initiatives. These are discussed below:

1. BALANCE technology, organization, investments

- ***legacy systems***
- ***new media***
- ***computing***
- ***communications***
- ***content***

The current situation is imbalanced: while computing resources are in place, there is no integrated network, nor adequate tools and policies for information dissemination. Similarly, even though computing is managed on both a central and decentralized basis, its management is not integrated. Most seriously, content is not managed as a public resource.

While the "new media" is much in the news these days, it simply does not have the capability to perform many of the "back-room" functions necessary to operate an agency. Thus, both the institutional and new media approaches are necessary. However, as the underlying economic and management models are highly divergent, the question becomes how to integrate them.

2. *UTILIZE the network as the basis for strategic linkages:*

- ***Within local agencies***
- ***Within the nation***
- ***Within ASEAN***

The Multimedia Super Corridor (MSC) project involves attracting and nurturing a cluster of enterprises to peninsular Malaysia, which will develop several flagship applications, including: Telemedicine, Smart Schools, Multimedia Funds Haven, Multimedia Research and Development Cluster, Electronic Government, Worldwide Manufacturing Web, and Borderless Marketing Centre. These will be useful to local government.

3. *INVEST in IT manpower TECHNICAL & MANAGERIAL*

- ***Overseas education in emerging technologies & IT management***
- ***Seminars to inform and motivate the general public***
- ***Workshops for management***
- ***Training for empowered end-users***

Social intelligence originates not in tools, but in a community's ability to sense and interpret the environment, learn quickly about opportunities and threats, and use the knowledge to adapt and modify itself and the environment. Intelligent communities must therefore be able to "maintain and improve standards in the learning of basic communication and numerate skills by children, their business corporations will be committed to the intellectual development of their employees and, above all, they will create large subcultures which work at the creation of an advanced infrastructure with such energy that their enthusiasm spreads to their fellow citizens." (Wriston 1992)

4. *LEVERAGE available resources:* public and private

- ***Internal***
- ***Local Vendors***
- ***Overseas IT suppliers***
- ***National Telecoms Operators***
- ***Regional Universities & Schools***
- ***Service Industries***

Around 1980, Singapore shifted to a skill-based economic strategy designed to attract investment from higher value-added industries. At this point there were less than one thousand IT workers in the entire country, and this shortage received immediate attention through a combination of overseas education, local training, and immigration. Local government must invest both in developing its young, and in retraining the current work force.

4. *DEPLOY a broad range of IT-based solutions & adapt processes*

Integrating the new media is largely a function of architecture, and virtually every information technology has a potential role in the plan.

Point-of-Sale (POS) technology is an example of a solution that may transfer from the private sector into local government operations. Retail operations use intelligent cash registers equipped with simple bar-code readers to scan in products as they are sold, and compare the product code to a price list to calculate the amount due, then send a message to inform headquarters of the total collections, which can be compared to bank deposits. The Treasury function in Government could adopt both the hard technology and the "soft" management control systems from the private sector.

5. *STRUCTURE supply:demand relationships over time*

ESTABLISH 4 Strategic Data Hubs

- ***Financial Management***
- ***People***
- ***Enterprises***
- ***Natural Resources***

Public sector data resources around four main hubs: finance, people, enterprise, and natural resources.

Financial- Effective management of a government budget and cash flow requires an understanding of interactions among various internal and external factors, and to make adjustments in spending and other plans in real time. An online financial model, linked to external databases and internal financial and treasury systems, would serve such a purpose.

People- While its people are the heart of any government; many critical interactions (especially health, education, and public safety) lie in the domain of the Federal government. For local government, manpower development is the focus.

Enterprises- If business is the vehicle to carry the Government economy forward, then enterprises (and especially those that are now small to medium size) represent its engine. Government could use IT to nurture local enterprise, help them establish links with overseas suppliers and clients, and as a source of specialized services and skills.

Natural Resource- Local government's geographic diversity is an obvious example of a strategic resource, and the Government has a long history of attempting to improve its process management through the use of geographic information. Fueled by cheaper, faster hardware, improved and increasingly cheaper GIS software, and a broad range of potential applications, network-based GIS offers large benefits at low marginal costs once initial geocoding is in place.

Implementation Issues

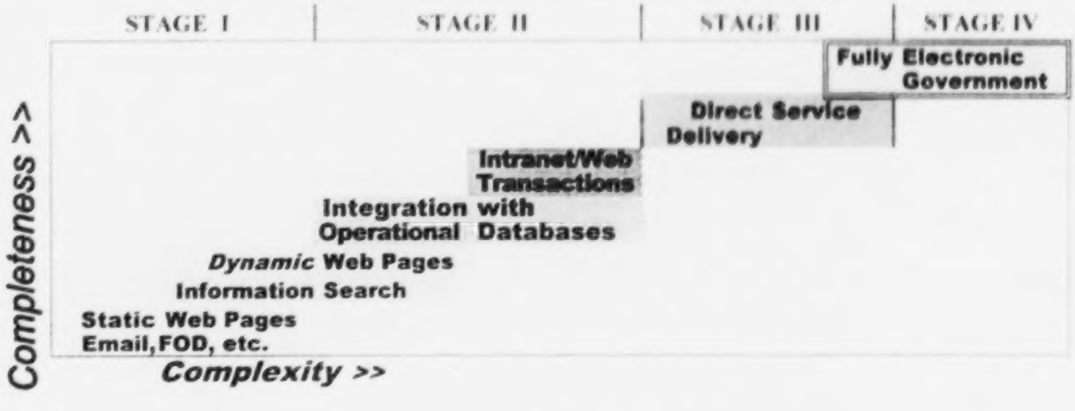
Given the current situation, the issue is how to move forward without risking failure, wasting scarce resources, or losing valuable time waiting to see how things turn out. The answer is to put systems in place in such a way as to achieve harmony among the different elements and opposing forces. For example, data sharing represents the harmonious use of resources. Sharing data results not only in economy, but also in more accurate data, as more people will be exposed to the database, and each will bring a slightly different perspective. Similarly, coordinating the efforts of agencies not only improves efficiency, but service quality.

The six strategies listed above represent the major initiatives for action. As harmony can follow only when each individual action programme conforms to all six initiatives, each of the action programs listed below should be interpreted in the context of the entire set of six "BUILDS" initiatives.

The "BUILDS" Action Plan

The vision is to achieve administrative renewal and bring the Government closer to its citizens through a fully electronic government by the year 2002. "BUILDS" can be deployed in four discrete stages, each of which provide immediate value and prepares the way for the next.

Figure 1: Stages in "BUILDS" Deployment



As the figure above indicates, each stage requires advances, both in the completeness of the strategic vision, and toward managing the complexity of its underlying technology.

The initiation stage builds on current infrastructure and capability. This stage should be accelerated as much as possible, and focus on providing the highly visible value of connectivity and access to public information, meanwhile acquiring the experience and establishing the technical standards necessary to move on to Stage II. From an external perspective, the Local government net raises public awareness, and builds support for the project. Email and facsimile access to services enhances the public image of IT-based services at relatively low cost. A complete catalogue of public information defines the inventory that will eventually be provided to the public over the network, and enables policy makers to formulate information dissemination policies. The acquisition and integration of a third-party search engine to deliver available public data is a highly visible step toward fulfilling the early promise of an electronic government.

From an administrative renewal perspective, simply providing governmentwide email links among offices can improve internal workflows, while radio paging and voicemail will improve coordination among field workers and their administrative bases, and the responsiveness of public services. During this stage, it will be necessary to define standards for electronic distribution of reports, forms, procedures, and other internal documents, as well as the standards for electronic publishing including procedures and guidelines for managing access to all public information through electronic media. This stage builds up the organizational and technological capacities necessary to overcome present barriers to electronic government. These are: [1] an inadequate public and Government telecommunications network infrastructure; [2] weak information technology architecture to enable the necessary level of connectivity and data sharing; [3] a lack of data administration, and [4] scarcity of the skilled manpower resources, both technical and managerial, needed to build, operate, and manage government-of-the-art IT infrastructure.

By enabling public access to GIS information, this stage of the "BUILDS" visibly reinforces the promise of an open information access policy. In placing government job opportunities online, the strategy creates a more efficient labor market and supports the Industrial Masterplan. During this stage, the Government must take its initial steps toward the strategic applications that will lead the way toward Electronic Government. For example, a sustainable tourism prototype is an opportunity to attract high-income ecotourists, while generating global interest in the local economy. An electronic communities pilot will use Local government.net to weave a rich social fabric to bind the citizens of Local government more closely together. The electronic tendering prototype, easily rolled out on a trial basis to local IT vendors, is a move toward electronic commerce.

Extending governmentwide email links to all offices is an incremental step toward the long-term goal, while development and testing of a distance training prototype for IT workers helps build the skills necessary to implement the plan, meanwhile providing experience in managing distance education. A governmentwide data administration initiative is a critical step toward managing its growing data resources as a corporate asset, and is also a prerequisite to providing the online extracts of public information needed for effective transaction processing in later stages. Underlying each of the above activities and tasks is the development of governmentwide network management capabilities, and the design of an information and network architecture to provide high connectivity and reliability at an affordable cost.

During this stage, the Government can exploit the results of the initiatives from earlier stages, for example by rolling out the advanced multimedia facsimile technology to add value to the fax-on-demand services to the more remote communities. Service quality management will be an important activity during this stage [6]. One useful approach to this problem is to identify gaps between the expectations of citizens and the actual performance of the agencies[7]. However, most current approaches focus on the gap only at the interface between the citizen and the service, an approach which does not clearly identify the contribution of infrastructure, which will be necessary to evaluate the success of the plan.

By this time, the Government will be ready to deploy its lifelong learning field trials, which will complement the digital library prototype. But the primary focus will be internal. By providing multimedia links among key offices, data warehousing for all shared data, a government-wide voice and data network, GPS tracking of mobile resources, and developing an information resource management policy, the Government will be preparing for Stage IV, which will be led by a newly appointed Chief Information Officer.

The strategic "BUILDS" initiatives are large-scale, distributed applications of high social and economic impact that contain an extensive information-processing element and that can benefit greatly by building an underlying information infrastructure.

Digital Libraries

A digital library provides access to a knowledge center without walls, open 24 hours a day, accessible over a network. The Government must support basic and strategic digital libraries and the acquisition and demonstration of digital publishing technologies, which can later be used in other "BUILDS" applications:

- *Technologies for automatically capturing data in all formats (text, images, speech, sound, etc.), generating descriptive information about such data (eventually including translation into other languages), and categorizing and organizing electronic information in a variety of formats.*
- *Advanced algorithms and intelligent interactive Internet-based tools for creating and managing distributed multimedia databases and for browsing, navigating, searching, filtering, retrieving, combining, integrating, displaying, visualizing, and analyzing very large amounts of information in inherently different formats. These databases are frequently stored on different media that are distributed among heterogeneous systems across the Government and around the world.*

Electronic Communities

A small and extraordinarily diverse citizenry populates a large land area. To avoid their isolation from today's age of global information, the government should provide Internet access to the general population through the public libraries, and foster a strong sense of community by:

- *Creating online environments to foster the free exchange of ideas and knowledge about work, play, and other communities of interest, such as gardening, sailing, computer games, or the environment.*
- *Creating online environments that support communities of relationship, for example in childbirth, aging and other life experiences that are often far less difficult if experiences can be shared with others.*
- *Creating channels for feedback from citizens to their government.*
- *Crisis and Emergency Management: large-scale, time-critical, resource-limited problems such as managing natural and man-made disasters are another vital initiative. Effective action involves command, control, communications, and intelligence systems to support decision-makers in anticipating threats, formulating plans, and executing these plans through coordinated response.*

Lifelong Learning

The Government must position information technologies as a resource to enrich and accelerate education, training, and learning systems for people of all ages and abilities. The "BUILDS" approaches this challenge from several directions:

- *Distance learning will provide access to specialized resources in a timely manner for geographically widespread students.*
- *Teacher training leverages the resources available to adult education programs.*
- *Students will have more equal access to information and data resources now only available at research and library centers.*
- *Lifelong learning provides educational opportunities to populations regardless of age or location.*
- *Digital libraries will make information available throughout the network -- both for professionals as well as students at all levels.*

The strategy must provide network access and conduct pilot projects to demonstrate information technologies for improving learning and training and that can be scaled to Governmentwide coverage.

Conclusion

The plan will take full advantage of the national Multimedia Super Corridor project, which will integrate communications, data management, and security services to enable the automatic exchange of business information among different organizations. Communications services transfer the information from the originator to the recipient. Data management services define interchange formats for the information. Security services authenticate the source; verify the integrity of the information received; prevent disclosure by unauthorized users; and verify that the intended recipient received the information. Electronic commerce applies and integrates these services to support business and commercial applications such as electronic bidding, ordering and payments, and exchange of digital product specifications and design data.

This will require a common underlying trusted third-party infrastructure to deliver authentication, authorization, accounting and banking services, usage metering, and fee- for-access within networks and distributed systems. This can be obtained either via the MSC platform or from a large-scale private sector effort (e.g., Visa's SET solution). Government can collaborate with industry to develop and apply technologies that enable electronic commerce in general, with an initial emphasis on those industries that are strategic for its industrial development [8].

Service quality will play a key role, and State government should begin now to establish a baseline understanding of the expectations that citizens hold (or can be expected to hold following deployment), and put service quality management processes in place to meet those expectations. While service quality management tools such as SERVQUAL are useful, they must be adapted to the problem of assessing services delivered over the infrastructure, a new used that will require research and validation.

In summary, infrastructure is an essential element. The basic telecommunications infrastructure plays a key role, supported by value-added networks, the national MSC project (even if somewhat delayed by the current fiscal crisis), and local agencies and its allies. Teamwork among these organizations will be critical factors in the success of such a plan.

REFERENCES AND NOTES

1 Hax, A and Majluf, Strategic Management: an integrated perspective, Prentice-Hall, 1984.
2 Han Chun Kwong, "Malaysian Information-Rich Society in 2020," seminar for Government, 1996.
3 op. cit.
4 Thorson, S; as cited in Caldow 1996.
5 Berman, J, as cited in Caldow 1996.
6 Donnelly, M et al; "Measuring service quality in local government - the SERVQUAL approach," International Journal of Public Sector Management, Vol 8 (7), 1995, p. 15-20.
7 Ziethaml, V, et al, Delivering Quality Service, Free Press, New York, 1990.
8 See http://obelisk.nmi.net.sg/gitis.index.html

When the Detour Becomes the Highway:
The Future of Alternative Routing

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ABSTRACT

Alternative telecommunications carriers have undermined the traditional bilateral operating agreements/accounting rates regime by offering consumers less expensive options. The resulting liberalization of telecommunications was inevitable. Although long-established large players are now adopting alternative calling procedures themselves, small, independent alternative firms will continue to be able to compete because business success in current telecommunications depends on factors that have little to do with sheer size. Governments that recognize the continuing advantages of liberalization and deregulation will deliver maximum benefits to their citizens and economies. One area that can benefit especially is the establishment of investment capital markets in emerging economies.

During the Middle Ages, Flemish merchants wanting to buy or sell goods in Milan had to traverse a narrow pathway along the northern shore of Lake Geneva. They paid a tidy sum for this privilege however, thanks to the Chateau de Chillon, a shoreside fiefdom controlled by the Duke of Savoy. If a goods-laden caravan tried to brush past the Chateau's toll collector, a troop of armed riders would pursue it and quite effectively exact the toll.

Comparing this to the traditional telecommunications system may exaggerate matters, but not beyond recognition. Traditional PTTs and PTOs can be said to have carved up the telecommunications realm like feudal lords dividing up territories. In the absence of alternative routes they could levy maximum tolls, and generally have.

Admittedly, one could argue that the motivations of the medieval fiefdoms were overtly mercenary, while those of the PTTs involved the more complex ideas of the natural monopoly, cross-subsidization and universal service. For now, let us simply mention the well-known tendency of monopolies to overcharge and underserve their customers, and add that both tendencies have been amply present in telecommunications regimes. On the old highway of half circuits and correspondent relationships, the monopolists faced no competitive pressures forcing them to reduce overhead and other costs or to improve service. When one possesses the primary route between Flanders and Milan, one finds oneself thinking of good reasons for charging higher tolls, just as one finds little incentive to repair potholes.

Various forces could undo such a monopoly, but the most obvious would be the development of less expensive alternate routes. If merchants could fly their goods to Milan or ship them by truck, boat, or railroad, then any Chateau that exacted a high toll on passers-by would soon have no passers-by.

Here the analogy becomes more obvious. For over a century, the old bilateral operating agreement/accounting rate regime offered the only route available for termination of international traffic. But what telecommunications "ships" is information; and information is, increasingly, packaged in such a way that it resists attempts to contain its transmission. It is becoming ever easier to find clever ways around PTT control of bottleneck facilities. When strategies such as callback, refile and bypass came along, it was inevitable that someone would notice that they offered an inexpensive alternate route to the old monopolistic highway, and it was inevitable that consumers would climb aboard. In 1993, for example, the first Japanese consumers of callback were faced with the choice of paying incumbent operators ¥200+ a minute to place a call to the U.S. versus paying callback operators ¥75 for the same call. This was not a difficult choice to make.

The majority of monopolistic regimes and their regulatory accomplices have only recently begun to respond to the forces of market liberalization and technological revolution. PTTs have, after all, enjoyed a monopoly for over a century. A recent study by Frost and Sullivan estimated that AT&T alone could lose $350 million a year worth of international revenue to Internet telephony by 2001, and updates to this study are increasing that figure across the industry. But most agree that the trend cannot be stopped, any more than contemporary travel from Bruges to Milan could be restricted to a narrow pathway traversing the gates of the Chateau de Chillon. While significant opposition to liberalization remains, it is increasingly acknowledged that this amounts to futile rear-guard action. In the artificially inflated market of international long-distance telecommunication, alternative carriers were an inevitability, and so was their success.

Skeptics have wondered just how long that success will last. Don't the large, established players have the resources to trounce the upstarts at their own game? This question arose with the advent of callback. Low-cost digital switching, plus competition in liberalized markets (notably the U.S. and UK), had led inevitably to the export of low-cost dialtone. Callback was, in essence, the exporting of competition to non-competitive markets. It was bound to succeed for the simple reason that it gave consumers and businesses extraordinary price advantages. The result was, inevitably, a downward pressure on the incumbents' collection rates. For example, in Kenya, the cost of a call to the USA fell from the 1993 rate of US$6 per minute—with a three-minute minimum length—to today's rate of $3/minute. The cost of sending a one-page fax to the U.S. fell from $18 to $3—attributable, primarily, to the competitive pressures introduced by callback.

Why Alternative Carriers Are Here to Stay

But could this change the roster of major players for more than a brief moment? Until the spring of 1996, *The Wall Street Journal* assumed that it would not. Once collection rates were adjusted downward, it reasoned, the arbitrage advantage of callback would disappear. And so, the *Journal* assumed, would callback firms.

By 1996, however, *The Wall Street Journal* began to realize that while callback itself may disappear, callback firms themselves would outlast the technology responsible for their birth. Let us consider several reasons why. One factor, necessary but not sufficient, is the continuing emergence of new technological tricks from up the independents' sleeves. Alternative carriers have, for example, gone into refile and by-pass. Today, if a call from Southeast Asia to the UK costs US$.005/minute less when routed through the U.S. on an ISR route than it does when placed directly at settlement rates, then the traffic is more likely to flow through the U.S. than to take the direct route.

The reason this is not sufficient to keep alternative firms competitive is, of course, that the arbitrage advantage represented by refile will again disappear. An estimated 50% of the world's telcos are refiling traffic. Moreover, in some markets, over 20% of customers are using callback. AT&T itself now offers callback. And Internet telephony will follow the same pattern. The detours, in short, have now become the highway. Couldn't the independents, again, be hoisted by their own competitive petards?

For several reasons, I don't believe so. For one thing, as *The Wall Street Journal* noted in 1996, callback offers a strategy by which alternative carriers can enter a previously monopolistic market, build a sales force, develop a customer base, gain brand recognition, and form strategic alliances. With these advantages, successful callback companies can migrate to private-line resale and full, facilities-based competition.

More basically, technological advances have changed what constitutes key competitive advantages in our business. To understand this, consider first that advances in fiber-optic technology have dramatically decreased the cost of transmission. William Carter of Submarine Systems, Inc., one of the leading researchers in fiber-optic technology, has said that his R&D engineers see "no end in sight" to the increasing bandwidth and transmission capacity of each new generation of submarine fiber-optic cable. Another factor reducing the limitations of bandwidth is asynchronous transmission. Between these two technologies, supply of bandwidth is no longer a limiting factor.

What this means is that technology is reversing the traditional cost structure of the industry: the cost of transmission is now becoming lower even than the cost of switching. In a competitive environment, transmission becomes virtually free. Under the old monopoly-based paradigm, telecommunications services were treated like platinum—an expensive, rare commodity. Under the new paradigm of alternative calling procedures, telecom services become as abundant as water. The new generation of telcos, with access to cost-based transmission, are increasingly passing these benefits along to customers in the form of low-price, high-quality service.

With transmission a minor cost of doing business, telcos will now be competing on bases that have little to do with sheer size. They will compete on the basis of their sales ability, their customer service, and their efficiency—their ability to keep general and administrative expenses at a minimum. Those who can attain the lowest overhead without sacrificing quality will succeed.

And here is where a hidden advantage of the alternative carriers lies. Surprisingly, it is often the small, independent telcos that can maintain the most favorable ratio of employees to volume of traffic. Without a tradition of bureaucracy, the independents have from the start been oriented toward maximal leanness and meanness. However much the majors try to downsize, some will never be able to surpass the independents in these efficiencies.

For all these reasons, then, the competitive landscape of international telecommunications has been permanently altered. The example of Sprint and MCI is relevant: when the U.S. market was liberalized, these firms were unknown, but today they are major forces. Moreover, now that telecommunications is becoming affordable to so many people, the sheer size of the telecommunication market is becoming so huge that capturing even a small slice of it is enough to make an independent company very healthy.

Ahead of the Power Curve

For these and other reasons, trying to prevent the transition from a monopolistic to competitive paradigm is like jamming one's finger in the dike when water is already pouring over the top. The more far-seeing regulatory authorities already understand this. A case study illustrates the direction they are taking. In April of 1997, USA Global Link President Larry Chroman visited Japan and announced the introduction of its Global InterNetwork℠ system, which will provide voice telephony services that work from telephone to telephone but are carried via the Internet. The Japanese media was enthusiastic about the idea, but Japan's Ministry of Post and Telecommunications (MPT) was not: it informed Global Link that Internet telephony was illegal in Japan.

However, the MPT thought further about the implications of the new technology, and as a result, reversed its initial ruling. In July of 1997, the MPT announced that as of August 1st, Internet telephony would be fully legal in Japan. What was perhaps most interesting about its announcement was that simultaneous with its sanctioning of Internet telephony, the MPT announced that Japan would open the door to international simple resale. Like Internet telephony, ISR allows traffic to flow between countries while staying outside the traditional accounting rate system, so that the only costs involved are the costs of transmission and the cost of ingress and egress from the PSTN at either end. These costs are generally minimal.

In short, the MPT realized that both these technologies represent a de facto convergence of voice and data, with all the implications this entails for the pricing of voice telephony services. Whether we like it or not, the convergence of voice and data is unstoppable. We can choose to position ourselves behind the power curve or ahead of it. The Ministry of Post and Telecommunications in Japan made a wise choice. The situation illustrates an observation from the report of the ITU's Sixth Regulatory Colloquium on the Changing Role of Government in an Era of Telecom Deregulation: "It is apparent that the impact of convergence upon regulation will be greater than the impact of regulation upon convergence."

In contrast to Japan's enlightened decision, current attempts to plug the crumbling dike of monopolistic restrictions are failing; the water is indeed coming in over the top. The most forward-thinking PTTs and PTOs realize this, and are learning to surf the new wave.

Convergence and Emerging Markets

Surfing these waves has many benefits to offer to the countries the PTTs serve. I have written elsewhere about ways in which the new paradigm of telecommunications offers economic benefits to emerging societies around the world. I would like to point out one other such benefit. When telecommunications and transportation infrastructures are undeveloped, businesses must be in close proximity if they want to communicate with each other. This is the origin of crowded commercial centers such as Wall Street, the Ginza, or downtown Bombay. But with the development of the global information economy, people will be able to live anywhere and still work together. They will be able to commute instantaneously. They will be able to know anything known anywhere to anyone else instantaneously, at virtually no cost. The implications for global commerce and global financial services are obvious, and this holds special promise for emerging nations seeking investment capital, export markets, and relief from the overcrowding of capital cities. Convergence, therefore, not only involves data, fax, voice, video and multimedia services, but also the convergence of telecommunications with information technology, finance and commerce.

All of this is going to come to exist on the world's new fiber highways. How can the Asia Pacific region maximize its access to this highway? The region is characterized by national economies that range from those that are very advanced economically and technologically—e.g., Japan, Singapore, and South Korea—to those at the other end of the spectrum, e.g., Myanmar and Mongolia. The highly developed are in a position to enjoy the benefits of the new free-market paradigm immediately, since they already have a telecommunications infrastructure to take advantage of this change. All that needs to be done is to open it up to competition. The less-developed economies are similarly in a position to open their doors to competition in the form of new market entrants eager to deploy the latest technology. This will allow less-developed countries to leapfrog to the latest technology rather than continuing to rely on inefficient monopolies for improvement that may never come. Thus, whether a country is poor or wealthy from a telecommunications perspective, the main factor inhibiting its leap into the 21st century, is antiquated regulations and restrictions on competition; and the main gateway to taking maximum advantage of the telecommunications revolution now underway is removing these same restrictions to competition.

That gateway is opening, either as it is being pried open effectively from without or advisedly from within. Indeed, traditional PTTs and PTOs are actually entering into alliances with aggressive independents like USA Global Link, to take advantage of the numerous opportunities inherent in a time of rapid change. Thus, not only is the detour becoming the highway; those who blazed the detour trails are among the new highway's chief engineers.

The story of Chateau de Chillon contains the seed of one more relevant principle. The companies that will thrive in the coming era will not be those that try to shore up their defenses and restrict access, but rather those whose innovation and efficiency enable them to contribute maximum value to their customers and shareholders. As future technologies unfold greater and more powerful possibilities, much will change, but I am certain that success will remain contingent on an aggressive pursuit of innovative solutions and increased efficiency in their deployment. This principle will determine the fate of individual corporations as well as nations in the next millenium.

The Amateur Radio Service National Resource for Disaster Communications and Human Resource Development

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1. Abstract

Today, the Amateur Radio Services continue to play an important role in disaster communications and development of technical skills in many countries. This is true because of a number of factors: (a) Amateur Radio operators are widely spreaded in populated and remote areas, (b) they can communicate at both short and long distances using a wide range of frequencies, (c) their links or nets can be reconfigured dynamically, (d) amateur stations have systems, including electrical power, independent of commercial or government networks, and (d) operators can adapt themselves to different situations through self-training and innovation. This paper concludes with some suggested actions countries can take full advantage of the resources of Amateur Radio.

2. Introduction

The International Telecommunication Union (ITU) Radio Regulations define these services as follows:

> *Amateur Service*: A *radiocommunication service* for the purpose of self-training, intercommunication and technical investigations carried out by amateurs, that is, by duly authorized persons interested in radio technique solely with a personal aim and without pecuniary interest. (RR S1.56)
>
> *Amateur-Satellite Service*:
> A *radiocommunication service* using *space stations* on earth *satellites* for the same purposes as those of the amateur service. (RR S.1.57)

First mentioned in the above purposes is self-training. This is carried out by experienced amateurs acting as mentors for those learning the required skills. Such training can be provided one-on-one or in classrooms as the situation requires. Many countries have taken advantage of operators and technicians trained in the Amateur Services in staffing their national telecommunications systems. Amateurs tend to be self-reliant and resourceful as a result of building and repairing their own radio stations. These skills are extremely useful in development of telecommunications stations and networks, troubleshooting problems, and in disaster communications.

3. Disaster Communications

The above definitions do not seem to include disaster communications. Instead, that role is emphasized elsewhere in the Radio Regulations. Resolution No. 640, adopted at the 1979 World Administrative Radio Conference (WARC-79), formally recognized the value of this resource, stating in part,

> "the stations of the Amateur Service, because of their widespread distribution and their demonstrated capacity in such cases, can assist in meeting essential communications needs:" and " in the event of a natural disaster, direct communication between amateur stations and other stations might enable vital communications to be carried out until normal communications are restored."

In the Foreword printed in the ITU fascicle, *Excerpts of ITU radiocommunication texts concerning the amateur service and amateur-slatellite service*, ITU, 1995, Radiocommunication Bureau Director Robert W. Jones stated:

> Amateur radio continues to play an important role in disaster communication. It has a unique ability to provide radiocommunications independent of the telephone network or other radio services particularly in the first few days before relief agencies are at the scene and have set up disaster telecommunication services.

4. Amateur Radio and UNDHA

The following is a view of the amateur services of the United Nations Department of Humanitarian Affairs (UNDHA) on The Role of Amateur Radio in Disaster Relief

> In the age of satellite telephones and information highways one important network is sometimes overlooked: That of more than 2.6 million Amateur Radio Stations world-wide. In many cases such stations have provided first information about a disaster and served as the only link to the outside world. The Amateur Radio Service has two distinct advantages: Many of its stations are independent of any infrastructure - they can work on own power resources such as batteries or generators, and they are operated by dedicated and skilled enthusiasts, many of which are masters in the art of improvisation. Amateur radio equipment therefore has a better chance to survive the impact of a disaster, and trained radio amateurs are best qualified to establish and maintain communications under the most demanding conditions, be it at their own stations or as volunteers who operate the equipment of rescue services and relief agencies.

Recommendation ITU-R M.1042, Disaster Communications in the Amateur and Amateur-Satellite Services, recommends:

> 1. that administrations encourage the development of amateur and amateur-satellite service networks capable of providing communications in the event of natural disasters;
>
> 2. that such networks be robust, flexible and independent of other telecommunications services and capable of operating from emergency power;
>
> 3. that amateur organizations be allowed to exercise their networks periodically during normal non-disaster periods.

5. Amateur Radio Activities

A couple of recent examples of Amateur Radio disaster communication in the Asia-Pacific region are reported by the member Societies of IARU Region 3.

5.1. Japan

The Japan Amateur Radio League (JARL) has reported that;

the Hanshin-Awaji Great Earthquake which struck early in the morning of January 17th, 1995, dealt a severe blow to the central part of Kobe city, Awaji Island and other vicinity areas. More than 5,300 were killed and about 100,000 houses were destroyed. The telephone network in Kobe city and other disaster stricken area was cut into pieces. About 361,000 circuits were cut off and this was a big obstacle for the initial movement of rescue activities.

To help alleviate the situation, many amateur radio operators in surrounding areas which were free from calamity, volunteered to play an active part in the transmission of information.

JARL took various measures to support communications in this emergency, conferring with the Ministry of Posts and Telecommunications, in view of the large scale of calamity caused by the earthquake and extremely limited availability of communication media for restoration.

First of all, JARL reopened a repeater station on

Mt.Ikoma. Furthermore, a repeater station in Kyoto was relocated to Kobe city.

With cooperation of the Japan Amateur Radio Industries Association (JAIA), JARL distributed 260 portable radio units to secure communications for refuge shelters in disaster-stricken areas. JAR acquired 332 licenses for these units prior to the distribution.
This Amateur Radio disaster relief communication was lasting about 3 months and finished on April 15th, 1995.

5.2. Bangladesh

Report of the Bangladesh Amateur Radio League (BARL) says that;
a strong cyclone with speeds reaching up to 250 km/h hit Bangladesh coastal belt on May 19th, 1997. The havoc caused by the cyclone disrupted the normal telecommunication links with the disaster areas.
BARL members in association with Red Crescent and other NGO's set up emergency radio communication links between the capital Dhaka and disaster areas. The amateurs came forward with their hands of co-operation immediately after the announcement was made that the cyclone with devastating force would hit Bangladesh.

Five or more amateur stations moved to the disaster area and set up HF and VHF stations both fix and mobile. The control station was located in Dhaka. For the next 72 hours, round the clock disaster communication channels were kept open by amateur radio operators.
Invoking the Resolution 640 of ITU, Red crescent and Radio Amateurs used all bands and frequencies that were available to them to pass disaster traffic.
In appreciation of their efforts, national dailies published back-page story titled, "BARL plays laudable role during cyclone".

5.3. Australia

In Australia, the Wireless Institute Civil Emergency Network (WICEN) is formed and functioning. This is the body which prepares the amateur fraternity for service to the community in civil emergencies.
The role of WICEN is to provide communications for support agencies such as Red Cross, Salvation Army and welfare organizations which do not have their own communications.
The chief advantage of the WICEN is their flexibility and mobility. It differs from all other services in that all WICEN members are volunteers who provide their own equipment and transport, whose only benefit from their activities is the satisfaction of being able to help others in a time of need.

Within each state, WICEN is organized into Regions. Each Region holds exercises and training sessions. Much training is carried out as community service supplying communications to the organizations to the organizers of events such as charity walks and fun runs, horse or car trials, bicycle rides or canoe marathon.

Examples of recent WICEN activities include the bush fires near Sydney in 1994, the Newcastle earthquake and floods in northern Victoria. Most Disaster Management agencies agree that the capability, versatility, mobility and availability of the WICEN volunteers are vital to the efficient management of a Disaster and are likely to remain so despite technological advances. Several small emergencies have already shown that though allocated frequencies become jammed, mobile phones cease to work, telephone lines become overloaded and electricity supplies may be cut off, the amateurs can still continue to pass messages.

5.4. Asia-Pacific in 1997

In 1997 alone, numerous natural disasters occurred in the Asia-Pacific region. Here is a partial list of major disasters in the region:

Afghanistan:	Floods	May 1997
Bangladesh:	Cyclone	May 1997
Bangladesh:	Flood	Aug. 1997
China:	Earthquake	Apr. 1997

China:	Floods	May 1997
India:	Earthquake	May 1997
India:	Floods	Jul. 1997
Papua New Guinea:	Cyclone	Mar. 1997

Amateur Radio played a part in some, but not all, of these natural disasters. Those where they did were supported by an active Amateur Service within the country, an administration that encourages Amateur Radio, and disaster communications planning.

Conclusion

This paper urges that appropriate actions be taken by each country:

1) to review and/or develop a National Emergency and Disaster Communications Plan;
2) to encourage, support, and incorporate Amateur Radio into the Plan;
3) to promote training of Amateur Radio; and
4) to allow the free movement of Amateur Radio equipment with free or low duty in view of national interests.

Emergency Services - Speaking With One Voice

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ABSTRACT

Over the past three years the South Australian Government has undertaken a program of standardisation, consolidation and rationalisation of the IT&T infrastructure. This has placed the State in a unique position to take a corporate view of the State Government and to undertake Public Sector transformation programs that will ensure we reap the benefits of this initial infrastructure investment.

The subject of this paper is the planned transformation of the Emergency Services sector in the State, initially by the introduction of a common Government mobile network (GRNC) and a common emergency services dispatch system.

The planned convergence of the Government's telecommunications mobile services will generate many benefits for the State, not the least of which is the provision of high functionality mobile telecommunications to rural/regional areas.

Many Police Forces in the world are currently evaluating replacing options for aging voice radio systems and mobile data will be increasing important in ability of police to serve the community.

Another imperative to the consolidation of emergency service centres is that the only reserved spectrum Australia is 64 paired channels in the 400Mhz band. These channels are only 25KHz wide giving our Police only a portion of the bandwidth available in many other parts of the world. Given the provision of mobile data infrastructure to Police will further drive demand for spectrum, this will increasingly become a limiting factor to Emergency Services capability in Australia.

DRIVERS FOR THE TRANSFORMATION

The key drivers for the transformation of the operations of the emergency services sector are the following:

- infrastructure – the need to improve communications in both metropolitan and rural areas, particularly to support rural Police and emergency services;
- economic – the need to reduce financial stress due to multiple systems in Government
- standardisation of infrastructure for consolidation of support centres
- introduction of world leading technologies and high functionality
- ability to enable both voice and data communications
- incorporation of new technologies such as broadband and multimedia and satellite
- the need for high reliability
- increased leverage by economies of scale

Information Technology is a key driver for innovation and reform. The return on investment in infrastructure will be increasingly evident through the benefits achieved in using the technology to reengineer existing Government business processes.

The aim is for better coordination and management of the activities of the variety of agencies within the emergency services sector - the South Australian Police (SAPOL), the SA Ambulance (SAAS), the Metropolitan Fire Services (MFS), the Country Fire Services (CFS) and the State Emergency Service (SES).

This undertaking will result in an improved and far reaching wireless infrastructure in the State Government, particularly for the 75% of users that are within the Emergency Services sector which may include volunteer emergency service workers.

More importantly, it will pave the way for significant changes to the way in which the emergency services sector conducts its operations, leading to improved response time and coordination of the emergency services and a better service to the public of South Australia.

THE TRANSFORMATION PROGRAMS

The transformation of the Emergency Services sector will be managed across four transformation programs which are underway in the State Government to facilitate the change that is required in the public sector.

These programs are as follows:

1. Service Delivery Transformation

This program focuses upon the deployment of technology to support one stop/non-stop service to business and the community, and the promotion of technology to support an improved customer interface.

2. Administrative Processes Transformation

This program focuses on the deployment of technology to support improved administrative processes in the public sector, including the use of technology to reduce cycle time, reduce paperwork, improve the efficiency of current processes, and support improved inter-agency collaboration.

3. Resource management transformation

The focus of this program is the use of technology to support the best practise management of Government resources. This will be supported by improved information about Government assets and human and financial resources.

The business process transformation can only be enabled by best practise information technology and communications. Consequently, the aim of the fourth transformation program (which underpins the others) is maintaining the Information Communication Services functional infrastructure.

THE GOVERNMENT RADIO NETWORK CONTRACT (GRNC) PROJECT

The Government Radio Network Contract (GRNC) represents the most exciting wireless telecommunications initiative in Australia today. The selection of a Service Provider to design, build and manage the telecommunications infrastructure called the Government Radio Service (GRS) for South Australian Government agencies over a seven year contract period is a significant step in the Governments plans to transform this sector.

There is an increasing urgency in progressing the GRNC , factors including:

- Government philosophy (whole of Government approach);
- VHF Band Plan requirements of the Australian Communications Authority (ACA);
- changing work practises;
- the need to replace aging technologies.

The GRNC will bring together into one network, 17 agencies using radiocommunications on 28 separate mobile radio networks currently across State Government agencies.

COMPONENTS OF THE MOBILE SERVICE

The Service provider will be required to manage the provision of a range of radiocommunications services and associated management services to participating agencies.

The Government Radio Service can be broken into 3 separate services purpose-built to meet agency requirements.

Voice services - support for mobile and portable radio terminals;
Data Services - support for mobile and portable data terminals;
Paging Services - support for alpha, numeric and tone paging.

To complement these services are associated management services to support the afore mentioned services.

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It is worth noting that the initial metrics are that the GRNC will impact upon 17 agencies using two-way radios, 12,000 portable and mobile radios, 8000 pagers and some 45,000 users of terminal equipment. Many of the current networks and terminals have exceeded their operational life.

Agencies not currently using the GRNC will be able to use it to meet its operational and functional requirements.

COVERAGE OF THE GRNC

The coverage of the GRNC is expected to include all settled areas of South Australia - an area of 226,000 square kms.

The Government is currently developing a rollout plan over 2 and half years and 5 separate business regions. Each of the Government agencies involved is currently assessing opportunities for Business Process Reengineering (BPR) in conjunction with the rollout of services.

Planning for the transformation will continue throughout the infrastructure build stage. The process will involve a move to the new services and decommissioning existing services.

Ways to ensure continuity of services for remote users are currently being considered, and it is likely that satellites will play a key role.

MOBILE VOICE and PAGING SERVICES

The infrastructure for the voice services associated with the GRNC will be a Motorola Astro SmartZone Omnilink mixed analogue and digital trunked UHF radio network. The preliminary design will utilise approximately 130 radio sites throughout the State linked to 4 Zone Controllers, providing approximately 700 traffic channels (employing variable density trunking concepts). The SmartZone will also support data functionality up to 3000 bps.

Paging services will have the same coverage of voice services. The service provider is to design, build and manage the infrastructure to support the paging service. Pager initiation will occur via operator, telephone, computer/dedicated consoles and alarms.

MOBILE DATA SERVICES

Mobile data services are becoming increasing important as the emergency services sector becomes reliant on remote access to its supporting computer systems. Mobile data will in particular play an increasing role in the ability of the Police to serve the community.

Data services will also provide for:

- dispatch function;
- Automatic Vehicle Location; and
- Support for Computer Aided Dispatch (CAD) project.

The Government is seeking a data network over the greater metropolitan area of Adelaide that will also provide a foundation for the Computer Aided Dispatch Project.

The South Australian Police is currently planning to use the new technology to lead the country in the use of ICS to transform their day to day police operations. In particular, a smart police car as a mobile office is now a reality.

Ultimately, a mobile data capability in the Police cars will ensure that the State Police have access to the electronic mapping capabilities, their legacy systems and the internet.

The SA Police are keen to put a community focus back into policing and they are developing prototypes of the mobile police stations - this will support the concept of the police in the community - data will be able to be moved directly between laptops in the cars and the police headquarters. The Police are currently tendering for a cradle that will fit into a patrol car and hold a conventional laptop.

Other applications, such as the ability to transmit video of accidents etc directly from the Police car to Headquarters are also being considered.

Opportunities for BPR also include the possibility of transmitting one report for Police and Insurance purposes.

EMERGENCY SERVICES DISPATCH SYSTEM

The GRNC will support other initiatives in South Australia such as the standardisation of the existing South Australian Metropolitan Fire and Ambulance Services computerised dispatch systems which are both over nine years old, have limited functionality and no longer meet their needs.

These critical systems are now subject to failure and need to be replaced. The South Australian police was at the leading edge of CAD when the Tiburon system was introduced. This included the use of Mobile Data Terminals to assist front-line officers. The community of South Australia has been guaranteed a high level of safety by this system. The Police CAD system, however, lacks the advantages of integration with other Emergency Services applications. The proposed CAD system will enhance the police capability in this area. The State Emergency Service (SES) and Country Fire Service (CFS) both use manual despatching as the frequency of their despatches to date has not justified separate computerised dispatch systems.

ICS SUPPORTING DISASTER MANAGEMENT

Computer Aided Dispatch Systems are essential tools for the efficient resolution of emergency calls, recommending the most appropriate resources and dispatching that resource. This is an application where poor response time, or mishandled coordination of resources, can lead to loss of lives.

Similarly, the GRNC will play an important role in emergency management in South Australia. The ability of police, ambulance and fire services to coordinate and work together in emergency situations will be enhanced by the common mobile network.

This is particular relevant in the South Australian environment where periodic disasters, such as the Ash Wednesday bushfires which in 1983 led to the loss of many lives, require maximum coordination and optimum deployment of emergency services resources.

PLANS FOR COMBINED CAD and SUPPORT CENTRES FOR EMERGENCY SERVICES IN SOUTH AUSTRALIA

It is currently anticipated there will be a need for one combined Emergency Services Communications Centre and one SAPOL Communications Centre at the current SAPOL site. This will mean rationalising the current number of communication centres.

It is proposed to install a new CAD system which will be common to both sites and each site will mirror and back up the other. In the event of total or partial failure of one site the other site will take over

Future additional benefits will be realised by

- flexible staffing -staff numbers reconciled with expected workload
- interfacing with other systems - such as Ambulance Billing
- opportunities for work practise reengineering
- common call taking - call takers taking the call from the community for several ESOs at once plus the ability to switch calls from one centre to the other in the event of an excess of calls or shut down

It is likely there will be significant amendments to Australian Telecommunications Act in the near future which will impact on the national emergency call taking (000) service. This may mean that direct call for emergencies will be devolved from Telstra to emergency services operations centres - adding considerable weigh to the call for rationalisation of emergency support operations centres.

INTEGRATION WITH OTHER STATE GOVERNMENT ACTIVITIES

Phase 1 of the CAD initiatives may include a mapping capability with assess to a map service supplied by the Spatial Information Program. (This is another initiative of the State Government which aims to ensure integration of State wide spatial databases).

Key elements of the CAD project are the provision of a Mobile Data facility to SAMFS and SAAS similar to that currently used by SAPOL, together with a basic mapping capability and the trialing of automatic vehicle location (AVL) for SAAS.

IMPACT ON THE COMMUNITY OF SOUTH AUSTRALIA

The main beneficiaries of the proposed common CAD system and the GRNC will be the community of South Australia. The public will benefit from

- faster and integrated response to calls to Police, Fire, Ambulance and SES;
- better coordination and management which in turns leads to a safer community;
- better information so that response is geared better to community needs;
- better utilisation of resources, in particular CFS and SES volunteers;
- agencies able to improve performance without increase in staff;
- better knowledge of location of resources leading to better asset management.

CONCLUSION

A modern CAD system that caters for Police and all Emergency Services and that interfaces with other whole-of-Government IT projects (to provide "seamless" access to information and communications), is in keeping with the State's leading edge information technology image.

The CAD System can only be built upon a platform of uniform Whole of Government wireless telecommunications. As the GRNC is progressively implemented across the public sector we will see the transformation of the Emergency Services operations. When the Emergency Services sector in South Australia is truly speaking with one voice, the Government will see the return on its investment in the infrastructure and the community of South Australia will reap the rewards.

Development of Voice Mail Service for Disaster Response
"Disaster Recovery Dengon Dial Service (DRS)"

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1 Abstract

NTT has developed a new voice mail service for use at such times as natural disasters when the telecommunications infrastructure is typically swamped by congestion and related problems. This paper describes the new system, called Disaster Recovery Dengon Dial Service (DRS), and the circumstances it is designed to meet.

2 Introduction

2.1 Background to Development

A major earthquake struck Hyogo Prefecture in Japan early in the morning on January 17, 1995. Extreme damage occurred in the Hanshin and Awaji regions in the west-central part of the main island of Honshu and its environs. The quake's magnitude was 7.2 and, because it struck nearly directly under the city of Kobe at a depth of only 20 kilometers, loss of life and property was immense. This was the worst natural disaster to hit Japan since the Great Kanto Earthquake of more than 70 years earlier, with 5,500 deaths and more than 100,000 residences destroyed just in the Kobe area. The telecommunications infrastructure of the area also did not escape the effects of this major quake.

The earthquake struck at dawn, so the only information available at first was "there was an earthquake in Kobe". Damage was broadcasted on TV gradually, so many calls were made from all over Japan to confirm the safety of blood relations, friends and businesses in the midst of an unclear, evolving situation. After the Kobe earthquake telephone traffic congestion occurred to a degree never before experienced in Japan. The number of incoming calls to the Kobe area from throughout the nation reached some 50 times normal peak congestion on January 17. The extraordinary congestion of lines even influenced to emergency calls for the stricken area, including those made for police or ambulance services. Some telecom facilities stopped functioning because of the earthquake, with about 285,000 or more subscribers temporally suffering interrupted communications.

This destruction of facilities contributed to more congestion as follows: 1) calls could not get through because of the destruction, 2) subscribers re-called several times in order to somehow get their calls through, 3) switches which were functioning also stopped working because they could not handle many re-calls. It was still 20 times normal peaks on the next day. NTT received criticism from around the country because of the large number of calls that could not go through. Normally, such congestion would disperse quickly, but in this case new disaster information was broadcast hour by hour, with the reported scale of damage rising daily. Thus it was not until January 22 that extraordinary congestion between Kobe and the rest of country disappeared (see Figure 1 and 2).

We found clearly from this major earthquake that the current network cannot handle large volumes of calls and become congested with numerous calls placed at one time

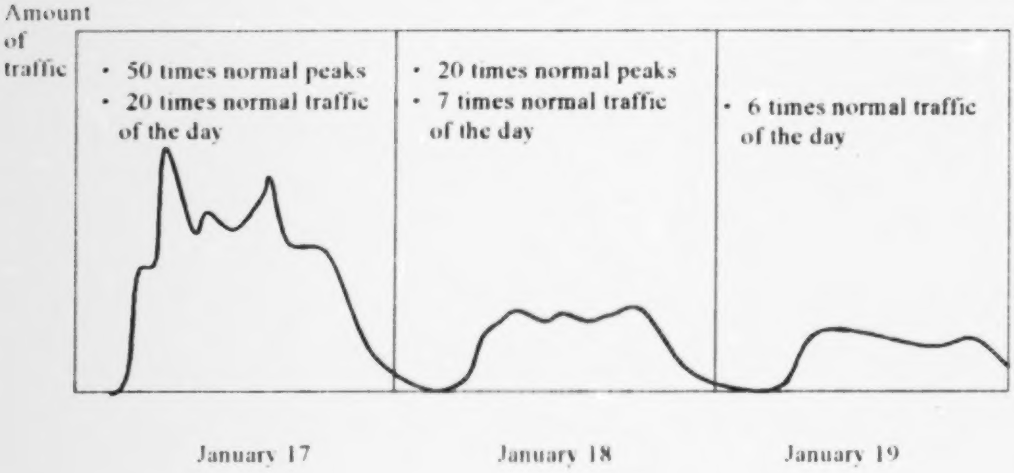

fig 1 Calls to the Kobe

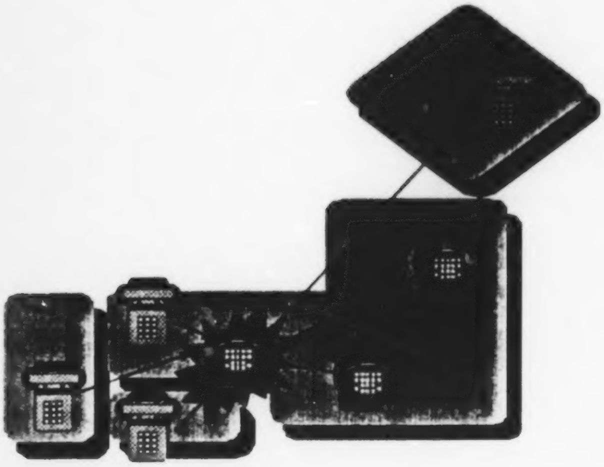

fig 2 50 times normal peak congestion toward the Kobe area

toward a particular area. In cases like this, NTT must regulate calls to a particular area to protect the entire network, because congestion from calls to a particular area may spread to prevent calls to other areas.

We also found that mass media can also contribute to network congestion. In the Kobe earthquake, the congestion did not occur right after the strike. However, people saw the damage on the TV, and the impact of this visual evidence added to viewer unease. Then millions of people made calls at the same time after these broadcasts, causing network congestion large enough to influence calls to other areas. During a few days after this disaster, a large portion of calls toward Kyoto and Osaka, areas peripheral to Kobe, could not get through (see Figure 3).

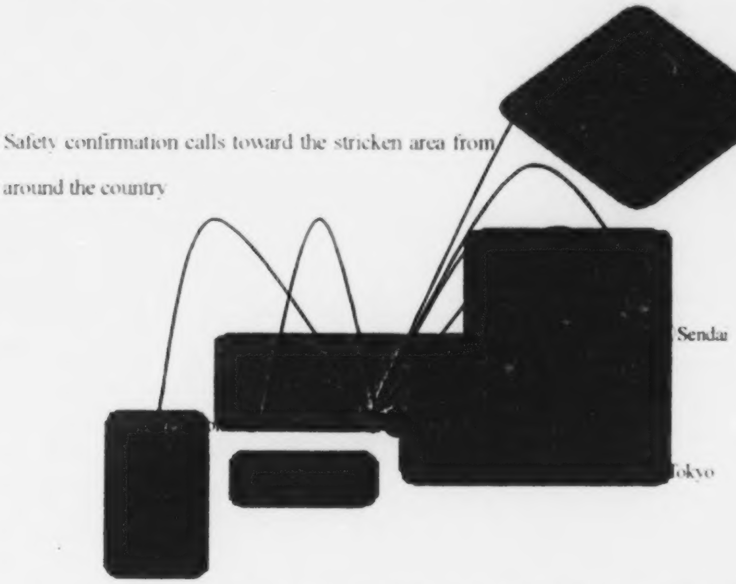
Safety confirmation calls toward the stricken area from around the country
Sendai
Tokyo

fig.3 Influence to peripheral areas to Kobe (Kyoto and Osaka)

2.2.NTT's Approach to Meeting the Challenge

Because of our experience in the Kobe earthquake, and the fact that it has been widely predicted that it is only a matter of time before a strong earthquake rocks the southern Kanto district which is also highly urbanized, NTT set up a Massive Disaster Countermeasures Committee within the company, drawing upon expertise over a wide range of technologies and systems. In addition to a wide range of a seismic and related countermeasures, the committee took a close look at the difficult problem of traffic congestion. Close study lead to a proposal of a new voice mail service which we have labeled Disaster Recovery Dengon Dial Service, or DRS for short. "Dengon" in Japanese stands for message. Preparations are now ongoing for launch of this service in March 1998. This system can record/play the information about victims in a disaster area, including whether they are safe or not. This system aims at sizably reducing congestion caused by calls toward a stricken area, and secures communications while also ensuring reliable means during a disaster.

In this service, voice storage devices are dispersed throughout the nation to help in reducing congestion. The system features automatic call distribution, giving priority to calls from a stricken area, enabling even rotary phones to be used to ensure universal. The voice storage system has a total capacity of 8 million messages, which is equal to the number of suffering families assumed when metropolitan area is stricken. It is also capable of parallel operation in the event two disasters occur simultaneously.

The system has two operations and maintenance centers, ensuring control to function even when one center is stricken.

3.Service Overview

The "Disaster Recovery Dengon Dial Service" is a non-contract type, voice storage service which enables communication between victims, or victims and a person outside a stricken area, when disaster occurs. One user accesses a voice storage center via telephone and leaves a message. After that, the other user accesses and hears/leaves messages. Users access the system via the following procedure.

1). Dial "171 (service number)"

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2). Following the guidance. Dial "1 (for leaving a message)", "2 (for hearing a message)", "3 (for leaving a message with password)" or "4 (for hearing a message with password)"

3). Dial a 4-digits password, as needed

4). Dial a "mailbox number (9 to 10 digits)". The mailbox number will usually be the telephone number of a victim

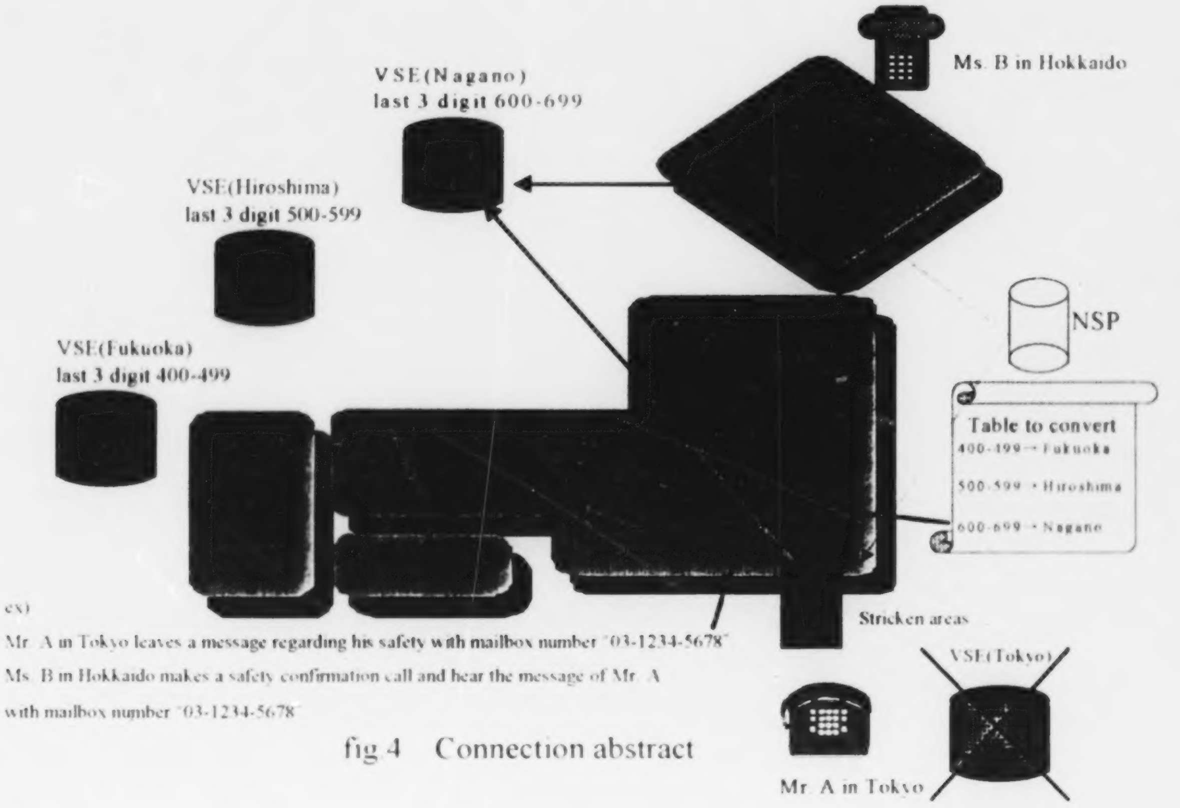
5). Afterwards, a user connected to a voice storage center and is able to leave/hear messages.

4.Major Service Functions

4.1.Distributed connection system

When a disaster occurs, telecommunications in a stricken area are subject to confusion because facilities may be destroyed, and telephone lines from the rest of the country toward a stricken area become congested with large numbers of calls confirming a person or organization's status. On the other hand, telephone lines from stricken area toward whole country, or from whole country toward non-stricken areas, are comparatively vacant. With NTT's new service, safety confirmation calls toward a disaster area are automatically distributed and connected to voice storage centers located in non-stricken areas.

For example, Mr. A in a stricken area dials "171 (service number)" + "1 (operation number for leaving a message)" + "03-1234-5678 (mailbox number, the mail box number will equal to Mr. A's home phone number), to leave a message regarding his status. The Ground Center (GC) switch transmits all the dialed numbers to a Network Service access Point (NSP). The NSP decides which voice storage center to be connected to from the last 3 digits of the dialed mailbox numbers. The NSP then indicates the center for connection to the GC (i.e. in this case, the mailbox number (home phone number) in the dialing procedure is "03-1234-5678", with the last 3 digits of "678". Therefore, the NSP indicates to the GC to connect to the voice storage center in Nagano prefecture which has been allocated by the service plan as the recipient of all calls whose last three 3 digits are "600-699".). Then the GC connects the call to the indicated center, and Mr. A leaves a message concerning his safety at that center (see figure 4).



ex)
Mr. A in Tokyo leaves a message regarding his safety with mailbox number "03-1234-5678"
Ms. B in Hokkaido makes a safety confirmation call and hear the message of Mr. A
with mailbox number "03-1234-5678"

fig.4 Connection abstract

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Alternatively, Ms. B who wants to confirm Mr. A's safety, dials "171 (the service number)" + "2(the operation number for hearing a message)" and Mr. A's home phone number. GC transmits all the dialed numbers to the NSP. The NSP decides on the voice storage center to be connected from the last 3 digits of the dialed mailbox numbers and indicates the center for connection to the GC. Then the GC connects the call to the indicated center, and Ms. B can hear the message from Mr. A.

In this way, calls originally made toward a stricken area are distributed to voice storage systems located throughout the country via the distributed connection function of this service (see Figure 5). As a result, safety confirmation calls can surely get through to voice storage systems in non-stricken areas. Moreover, congestion toward a stricken area will be reduced as safety confirmation calls are distributed, and emergency calls for police, ambulance and other emergency services can get through smoothly.

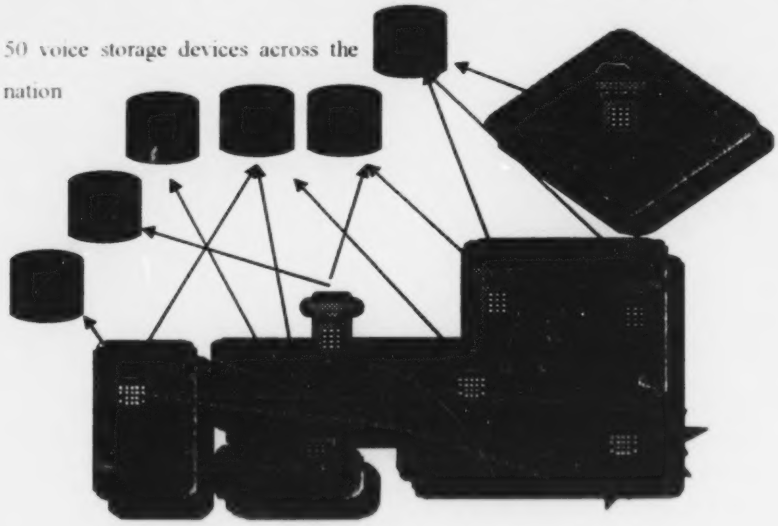

fig 5 Distribution of calls

4.2 Other Functions

The DRS has some functions to ensure smooth provision of service, and that the operations center can set up and control according to disaster scale. When disaster occurs, information from a stricken area is needed and thus should be given first priority. So the system functions to give this priority to calls from a stricken area, and regulates calls from other areas. To ensure the capacity of voice storage systems is not taken up by messages from non-stricken areas, the system functions to secure voice storage system capacity for messages from a stricken area by according to a set ratio of the entire system capacity.

In addition to those described above, the service also has functions for the convenience of users, to ensure that many subscribers can use this service without hesitation. The mailbox number for this system is the same as a victim's home phone number, so that users don't have to carry out any prior registration or other arrangement. Even rotary phones can access the system, so ensuring universal system access across the network. As during emergencies password use is sometimes inconvenient. Users can thus choose whether to employ password use. The network provides guidance instructions, step by step, as the user dials, because the dialing procedure described before is different from that for ordinary calls.. With this guidance, users can make calls easily.

5 Service Operations

5.1 Duplication of Control Center

No one can reliably predict when and where a disaster will occur. None the less, rapid response is needed once a disaster does occur. If a system is operated via only one control center, service cannot continue smoothly when the control center area is stricken. Thus a redundantly duplex, two-control-center is taken with this system. During operation of this service, the control center can

1). handle all 50 voice storage devices across the nation
2). give priority to calls and secure capacity for messages from a particular area
3). supervise network traffic for the whole country, which is necessary for smooth operations as described above.

5.2.Service Operation Details

When a disaster occurs, the control center takes care of the following details in keeping the system running smoothly.

1). Based on disaster scale, set up areas where the system will be available.
2). Establish a limit to the number of messages, how long messages will be retained, and how long in duration each message can be. All these parameters can be set at each voice storage device.
3). Regulate calls by area (stricken or non-stricken) and by purpose (leaving messages or hearing messages).
4). Establish and monitor call distribution so that the load at each voice storage devices is approximately equal.

All these details can be changed online, even while the service is running , except for 3). In addition, the control center can regulate the leaving of messages when service is going to be stopped.

6.When a Disaster Doesn't Occur

When disasters don't affect the country, NTT is considering providing voice storage system access to its subscribers as a gratis (other than normal call charge), non-contracted type voice mail service.

7.Toward the Future

The Kobe earthquake clarified that one weak point in the present telephone network is it becomes congested when a large number of calls are placed at one time toward a particular area during a major disaster. Disaster Recovery Dengon Dial Service aims at reducing congestion and securing communications even during such disasters. To achieve this aim, NTT has developed certain functions (such as a distributed connection system for large numbers of calls, and a new way of connection giving priority to calls from stricken areas).

For the smooth functioning of this service, publicity is a key factor. Not only NTT but working groups consisting of specialists and experts from related organizations and companies, including the national government (the National Land Agency), local government (Tokyo metropolitan government), and mass media (television/radio broadcasting companies) are now studying the best way to carry out such publicity.

At NTT we are confident this system will play a large role in reducing congestion and securing means of communication during disasters. Needless to say, we also hope such a disaster never occurs again and that are new system will remain unproven.

Partial Scramble Method for Distributing Digital Audio Data across Networks

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1. ABSTRACT

The remarkable advances made in audio compression technology has made it possible for a phone line to offer near-CD quality audio without download delay. The network will become the major distribution channel of audio data. However, digital data can be duplicated exactly, so it is strongly desirable to develop a system that prevents unauthorized copying and protects the copyright holder. However, it is also essential that the prospective purchasers be permitted to evaluate the data (music) before purchasing it. This paper introduces the "partial scramble method" to both prevent illegal copying of the original music file and make it possible to check the contents by scrambling the digitized music file to a controlled extent.

2. INTRODUCTION

The door has been opened to an era in which most audio data will be distributed across networks. The remarkable advances made in audio compression technology has made it possible for an ISDN(1) subscriber line to offer near-CD quality audio without download delay. Furthermore, PIAFS(2) technology has made it possible to enjoy music-on-demand with desirable quality outdoors (Figure 1). Digital audio data will become a significant network service.

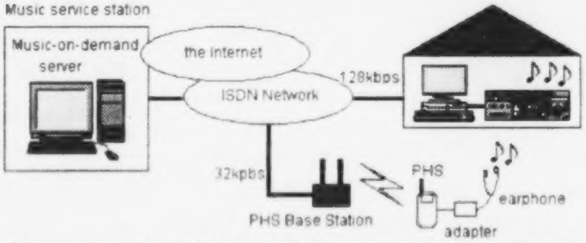

Figure 1. DISTRIBUTING MUSIC ACROSS NETWORKS

There is, however, a profound problem to overcome. Digital data can be duplicated with no loss of quality, and can be re-distributed easily. Therefore, it is strongly desirable to develop a system that prevents unauthorized copying and protects the copyright holder.

Preventing unauthorized duplication seems to require the use of cryptography. However, this triggers another problem. The users of the service must be permitted to evaluate the data before purchasing it. If the data is completely encrypted, such evaluations would be impossible.

To solve this problem, we have developed the "partial scramble method". Using this method, audio data is scrambled using cryptography to a controlled extent such that data quality is low enough to prevent its exploitation but high enough to permit the buyer's evaluation. The customer can listen to the scrambled audio before purchasing it. A digital key that unscrambles the data would be sent from the provider to the user after payment is received. With the key in the local machine, the customer is able to listen to the unscrambled, high quality music.

In this paper, audio compression is explained. Then, applications made possible by distributing compressed audio data are described, and the problem of piracy is discussed. After that, the "partial scramble method" is described and it is shown how the method assists in the safe distribution of digital audio data.

3. DISTRIBUTING AUDIO DATA ACROSS NETWORKS

3.1 AUDIO COMPRESSION METHOD

Presently, the most popular method used to store audio data is the PCM(3) method, which is simply sampling sound waves and quantizing them. This "uncompressed" method is used in CDs and is also supported by AU, AIFF, and WAV(4) formats. It has the following features:

- Number of channels : 2

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- Quantizing bit number : 16
- Sampling rate : 44100Hz

This means that a bandwidth of 1.4Mbps is needed to carry bare CD-quality audio.

On the other hand, the highest throughput we can get now from an analog phone line and a modem is 56kbps. Even if we use an ISDN subscriber line, we cannot hope to transmit more than 128kbps which is far too narrow to deliver CD-quality sound(Figure 2).

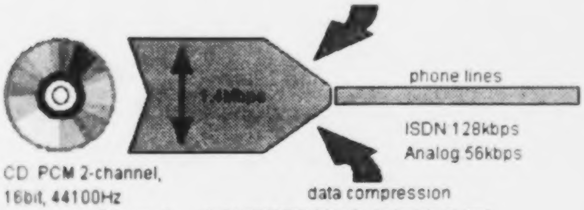

Figure 2. COMPRESSING AUDIO DATA

This leads to the compression of audio data. Recent developments in compression technology have made it possible to transmit near-CD quality audio through phone lines and replay it without download delay.

For example, the RealAudio format claims to offer the following characteristics(5).

- AM radio quality at 14.4kbps
- Stereo quality at 28.8kbps
- Near-CD quality over ISDN class connections

For transmitting data, it uses its own protocol which minimizes the impact of packet loss(6).

Another format, TwinVQ [Iwakami 95, Moriya 96] (Transform domain Weighted Interleave Vector Quantization) format has the following features:

- Variable bit rate and sound quality from AM radio quality (8kbps) to near-CD quality (96kbps - possible over ISDN connection)
- One of the candidates of MPEG-4/AUDIO(7)
- High degree of tolerance to encoding errors
- Compact decoding processing: can be decoded in real time with software

Due to its high quality at low bit rate and high degree of tolerance to encoding errors, the TwinVQ format is set to become the standard audio compression method.

3.2 DISTRIBUTING AUDIO DATA ACROSS NETWORKS

Now that it is possible to transmit high quality audio through phone lines, the system of distributing audio may gradually change. Already, concerts are "broadcast live" using the Internet, and there are many services that let registered members to listen to high quality audio.

However, the music market is much larger than what is currently being served through the network. Technically, the network can be the major distribution channel of audio data. The distribution of audio data is possible not only through phone line but also through leased lines, vacant radio bands, and by satellites.

There would be no need to go to record shops to buy CDs; simply download and listen to the music whenever desired. It would be possible to access music-on-demand servers using PHS, and it would be possible to listen to any music we want, anywhere and anytime. It would also be possible to buy the music of foreign countries whose CDs or tapes might be otherwise very difficult to find.

This new channel of distributing audio data would be profitable for those who make music. Not just the listener.

Artists who are not so famous or do not have enough money to publish CDs would be able to sell their own music through the Internet.

However, there is a profound problem in this distribution of digital audio data. Digital data are easily duplicated without any reduction in quality and without any cost. If people started to duplicate audio data and passed them to other people, it would be impossible to make money in the music market.

This is a very urgent issue. Before people really start distributing audio data through the network, there is a need to develop a way to protect copyrights and prevent unauthorized copying.

3.3 PREVENTING UNAUTHORIZED COPYING

To prevent unauthorized copying, the use of

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cryptography is essential. Only the encrypted file would be open to the public, and those who had paid the money required or who had contracted to pay the money would receive the key to decrypt the file and enjoy the contents. By splitting the contents into encrypted contents and keys to decrypt them, content distribution and charging would be made safer and easier.

However, when we think about the real business of selling and buying contents across the network, simple scrambling would not be the best answer. How could the customers decide if the encrypted contents were what they really wanted to buy? They would need a means to evaluate the contents before making the payment.

The "partial scramble method" was developed to meet the needs of both the contents provider and the customer[Abe 97]. The content is encrypted to a controlled extent so that it has no commercial value, but is sufficient to understand what would the contents are like.

It is also possible to make separate promotion files for the purpose of prepurchase evaluation. However, the "partial scramble method" is better than making separate promotion files in the following reasons.

- The contents provider can save time and money because there is no need to make separate promotion files.
- Both contents provider and the customer would not have to handle both the promotion file and the contents itself.
- To evaluate the audio data in depth, the customer can listen to any portion of the data or the whole part.
- Since the audio can be listened without download delay, there is no need to download useless data.

Features required for this "partial scramble" are as follows.

- The quality of the sound must be reduced so that it will not have commercial value.
- The features of the original audio must be recognized by listening to the "partial scrambled" audio.
- The descrambling algorithm must be fast enough to achieve on-the-fly replay.

4. PARTIAL SCRAMBLE METHOD

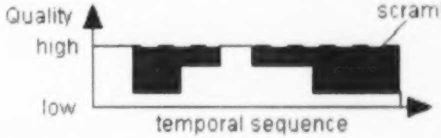
4.1 PARTIAL SCRAMBLE METHOD

In order to achieve the requirements shown in the previous section, there are two ways to control the scrambling of data (Figure 3).

- Alter sound quality in temporal sequence
- Reduce the quality of different sound features

The actual operation done depends on the audio format adopted, and I would like to describe this in more detail.

(1) Alter sound quality in temporal sequence



(2) Reduce quality of different sound features

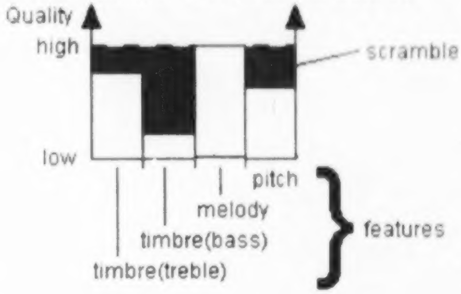


Figure 3. TWO WAYS OF CONTROLLING THE LEVEL OF SCRAMBLING

4.2 ALTER SOUND QUALITY IN TEMPORAL SEQUENCE

Temporal sequencing plays an important role in audio data. By either destroying, reducing, or changing the quality of some portion of sound with regard to time, "partial scrambling" can be achieved. There is no need to reduce the sound quality of the complete music piece to take away its commercial value. For instance, the sound quality of the music could be reduced for half a second every ten seconds. As another example, the sound quality could be left original for the first 30 seconds, and thereafter, gradually reduced. It is important to leave some portion of the music in its original quality or else the customer would not be able to perceive the original quality.

Usually in most of audio formats, data is arranged as a temporal sequence. As long as sound quality can be controlled in some form, it is possible to alter sound quality in a temporal sequence.

In the TwinVQ format, the sound quality can be controlled in time units of 1/20 th second, which is the period of one TwinVQ compression frame. This unit is short enough to achieve partial scrambling for any kind of music.

4.3 REDUCE QUALITY OF DIFFERENT FEATURES OF SOUND

Music consists of several features, for example, timbre, melody, and pitch. If these features can be controlled separately, it is possible to retain some features while destroying the others. For example, it is possible to understand the melody of the original music, while the sound quality is distorted.

For example, in the PCM method it is possible to scramble sound by swapping blocks of data in different temporal sequences. If the blocks are comparatively short, timbre is destroyed while if the block is long, melody is destroyed.

In many audio compression methods it is likely that distinctive features are extracted and coded separately. These type of formats make it easier to control the extent of scrambling. For example, in the TwinVQ format, each of the five coefficients of LSP(8), Pitch, Fw.Env.(9), Gain, and MDCT(10), represent a different feature of music. The extent of scrambling each coefficient can be controlled, and by combining the scrambling, it is possible to customize the result of scrambling so that it will fit the requirements.

4.4 THE SCRAMBLING ALGORITHM

The TwinVQ format is used as an example of a scrambling algorithm (Figure 4).

Each of the five TwinVQ coefficients consists of sub-coefficients.

The extent of scrambling is controlled by designating

- How many sub-coefficients are scrambled
- Which bits of the coefficients are scrambled

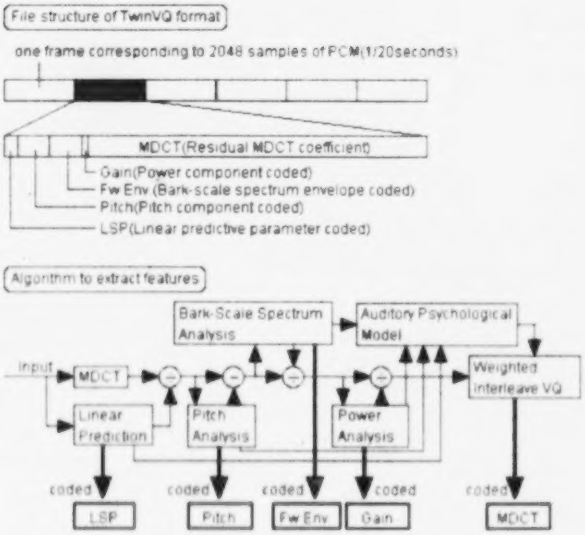

File structure of TwinVQ format
one frame corresponding to 2048 samples of PCM(1/20seconds)
MDCT(Residual MDCT coefficient)
Gain(Power component coded)
Fw Env (Bark-scale spectrum envelope coded)
Pitch(Pitch component coded)
LSP(Linear predictive parameter coded)
Algorithm to extract features
Bark-Scale Spectrum Analysis
Auditory Psychological Model
input
MDCT
Weighted interleave VQ
Linear Prediction
Pitch Analysis
Power Analysis
coded
coded
coded
coded
coded
LSP
Pitch
Fw Env
Gain
MDCT

Figure 4. TwinVQ AUDIO COMPRESSION

As more sub-coefficients are scrambled, the strength of scrambling is increased. When we change the bit scrambled, the quality of scrambling is slightly changed.

The scrambling is done in the following steps.

- First, each bit to be scrambled is chosen.
- Using a scrambling key, a random bit stream is created.
- Exclusive-or against the bit to be scrambled and the random bit stream is performed.

Unscrambling uses the same procedure.

To create the random bit stream, a cryptographic algorithm would be used. The strength of this scrambling method depends on the strength of this cryptographic algorithm.

The feature of using the exclusive-or operation is its high speed. This is important because we must achieve real time TwinVQ decoding and unscrambling.

4.5 EVALUATION OF THE PARTIAL SCRAMBLE METHOD

Using the algorithm described previously, we have developed a system to "partial scramble" audio data in TwinVQ format, and applied the method to actual music. The result of scrambling each coefficient is described below.

- LSP: The sound is strongly blurred.
- Fw.Env.: The sound is partially blurred. Lower sounds are especially thinned.
- MDCT: The sharpness in sound is lost, and non-pitched sound is added.
- Pitch: A somewhat metallic sound is added.
- Gain: The volume of the sound wavers

We have evaluated the effectiveness of the Partial Scramble Method using a subjective evaluation. The goals of this Partial Scramble Method were designated as:

- The scrambled music must be recognized as having worse quality than the original music.
- The scrambled music should not be extremely unpleasant.

The evaluation was done by having people listen to the original music and the scrambled music and compare the quality. The two questions below were asked in each comparison.

Q1) Choose the difference of the music from the following 3 levels.

1: The difference is obvious

2: The difference is difficult to recognize

3: No difference could be recognized

Q2) Choose the unpleasantness of the scrambled music from the following 5 levels.

1: Unlistenable

2: Somewhat unpleasant

3: Not unpleasant but weird

4: Not significantly unpleasant

5: Pleasant

Table 1 is the result of an evaluation done by 20 people.

	Q 1)			Q 2)				
Evaluation	1	2	3	1	2	3	4	5
LSP	18	2	0	11	8	1	0	0
Pitch	17	3	0	1	7	10	2	0
Fw.Env.	13	6	1	0	4	10	6	0
Gain	16	4	0	0	12	5	3	0
MDCT	16	4	0	2	11	6	1	0

Table 1. RESULTS OF THE EVALUATION

The following conclusions were reached from these results.

- When each coefficient was scrambled separately, for Pitch, Fw.Env., Gain, and MDCT, 80 percent of people said that the difference between the original sound was obvious.
- 80 percent of people thought the scrambling was not too unpleasant or not completely pleasant.
- Scrambling the LSP coefficient changes the sound too much.

This means that partial scrambling with the required features can be achieved by scrambling the Pitch, Fw.Env., Gain, or MDCT coefficients,.

We have already made some samples of scrambled music by combining different coefficients and have confirmed that a satisfactory level of partial scrambling can be achieved for different kinds of music.

5. CONCLUSION

This paper has proposed the Partial Scramble Method and applied it to the TwinVQ audio compression method. The system has the following features.

- It is possible to limit the feature of the music to be scrambled. Therefore, the original music can be discerned from the scrambled music.
- Scrambling can be controlled for each frame. This flexibility makes it possible to create a file that has, for example, a portion of music left unscrambled that allows the user to determine the quality of the original sound.
- The scrambling and unscrambling operation is done directly against the bit stream of the TwinVQ format, and the speed is very quick. Therefore, TwinVQ decoding and unscrambling can be done

in real time, and the unscrambled TwinVQ file may never need to be stored inside the user's computer.

We have evaluated the system by having people compare the original music to the scrambled version and have verified that:

- The "partially scrambled" music has worse quality than the original music.
- The "partially scrambled" music was not extremely unpleasant.

Notes

(1)ISDN: Abbreviation of **I**ntegrated **S**ervices **D**igital **N**etwork, an international communications standard for sending voice, video, and data over digital telephone lines.

(2)PIAFS: Short for "**P**HS **I**nternet **A**ccess **F**orum **S**tandard". It makes 32kbps data communication possible via PHS. PHS is a short for **P**ersonal **H**andy phone **S**ystem, and is a digital cordless phone system operating at 1.9GHz. PHS provides a very low cost service that can be used in residential, public, and office PBX settings.

(3)PCM: Short for **P**ulse **C**ode **M**odulation, a sampling technique for digitizing analog signals, especially audio signals.

(4)AU, AIFF, and WAV: Standard audio format for UNIX, Macintosh, and Windows95, respectively. AU is a short for **AU**dio, AIFF is a short for **A**udio **I**nterchange **F**ile **F**ormat, and WAV is a short for **WAV**eform audio

(5)http://www.jp.real.com/datasheets/client/index.html (in Japanese). In the English site, http://www.real.com/products/player/choice.html it only says that it offers "The Best Quality Audio and Video at 28.8".

(6) http://www.byte.com/art/9602/sec8/art1.htm

(7)MPEG is a short for **M**oving **P**icture **E**xperts **G**roup, a working group of ISO. It also refers to a family of international standards used for coding audio-visual information in a digital compressed format. MPEG-4 is a next generation standard aimed on multimedia applications. Its audio part would support natural audio coding at bit rates ranging from 2kbit/s up to 64kbit/s.

(8)LSP: Abbreviation of **L**ine **S**pectrum **P**air. LSP parameters are used to quantize linear predictive coding parameters efficiently.

(9)Fw. Env.: Short for **F**orward **Env**elope parameter. Here it stands for parameters calculated from the spectrum envelope after the LSP and Pitch components are removed from the original data.

(10)MDCT: Short for **M**odified **D**iscrete **C**osine **T**ransform. A form of frequency transformation. Here it stands for vector quantized MDCT coefficient after the LSP, Pitch, Fw.Env., and Gain components are removed.

References

[Abe 97] T.Abe, H,Fujii, and K.Kushima: "Image Distribution Method with Embedded Identifier Scheme for Copyright Protection", Proc. ACISP'97, Lecture Notes in Computer Science 1270, pp.325-336

[Iwakami 95] N.Iwakami, T.Moriya and S.Miki: "High-quality Audio Coding at less than 64 kbit/s by Using TwinVQ", Proc. ICASSP'95, pp.937-940, 1995.

[Moriya 96] T.Moriya, N.Iwakami, K.Ikeda and S.Miki, "Extension and Complexity Reduction of TwinVQ Audio Coder", Proc. ICASSP'96, pp.1029-1032, 1996.

PLANNING OPTIONS AVAILABLE TO P-TELCOS. IN INDIA FOR SETTING UP TELECOM. NETWORKS

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EXECUTIVE DIRECTOR, HFCL GROUP, NEW DELHI , INDIA

As per the National Telecom Policy announced by the Indian Govt. in May, 1994, competition was planned to be introduced in Basic Telecom. Services. Now, after a delay of more than 3 years during which the process of liberalisation was almost derailed, due to some what inflexible attitude of the Dept. of Telecom (DOT) , several private telecom. operators have already paid the licence fees and several are in the process of paying up. The planning process of telecom. networks to be set-up by private operators which, so far , was only on paper has been brought to some what practical shape and plans are being finalised and contracts awarded for execution of the projects.

2.0 The key issues which a private operator, setting up a new network in competition with a well entrenched operator with vast resources has to consider are.

i Fast roll out and rapid deployable network
ii Initial capital Investment
iii Network flexibility to forecasting errors.
iv Coverage and quality of service
v Future expansion.

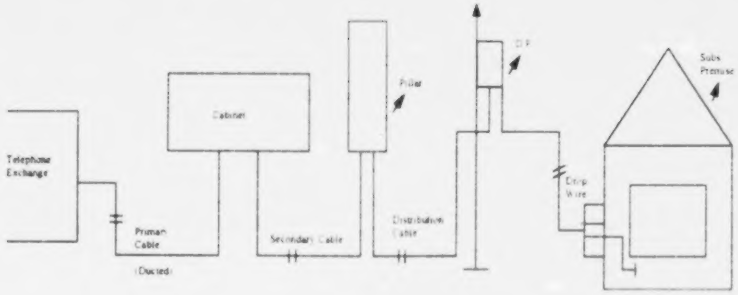
3.0 As per the tender conditions , the private telecom. operators are expected to deploy in the network, state of the art technologies for switches, long distance and the subscriber access networks. Further, a private telecom. operator is permitted to use metallic cable in the subscribers loop for the last 500 meters only. Due to these conditions a private telecom. operator will have to provide advance digital switches, set up high band width back bone network and for the subscribers access network, will have to take the fibre close to subscribers premises i.e. fibre to the curb (FTTC) or fibre to the office (FTTO) and the last 500 meters of the subscribers loop will be provided with metallic cable . For initial deployment and rapid rollout , Wireless In Local Loop (WLL) technologies will have to be used.

4.0 Existing Network: The Department of Telecom's existing network historically consists of a hierarchical network with a large number of stand alone switches from 128/256 lines in rural areas to 40,000 lines exchanges in metropolitan towns . The entire network of about 17.0 million installed line capacity has been provided with about 22,200 telephone exchanges . The backbone network connecting metropolitan towns, state capitals and primary switching centres has been provided with media diversity consisting of microwave routes for 100,000 kms. and optical fibre network for 50,000 kms. using PDH hierarchies. There is also an ageing 30,000 route kms. of coaxial cable network deploying extensively 12 MHz, 2700 Chl. analogue systems . A dedicated Indian Satellite network using multipurpose satellites for domestic communication and having more than 110 earth stations has also been set up . The satellite network in addition to telecom. services , also facilitates TV signal diffusion through out the country and provides meterological information for weather forecasting. For International communication, VSNL is the sole monopoly carrier having gateway earth stations in all the four metro-politan towns, as well as a dozen under installation in large towns . The subscriber access network is entirely with metallic cable utilising primary, secondary and distribution cables as shown in figure 1.

The pairage of different type of cables in the subscriber access network is generally within the following limits.

--- Primary cable 1000 to 2400 pairs.
--- Secondary Cable 200 to 800 pairs.
--- Distribution cable 100 to 10 pairs.

The Primary cable is generally pulled through ducts laid in sand and secondary /


Telephone Exchange
Primary Cable
(Ducted)
Cabinet
Secondary Cable
Pillar
Distribution Cable
DP
Drop Wire
Subs Premise

SUBSCRIBER ACCESS NETWORK

FIGURE 1

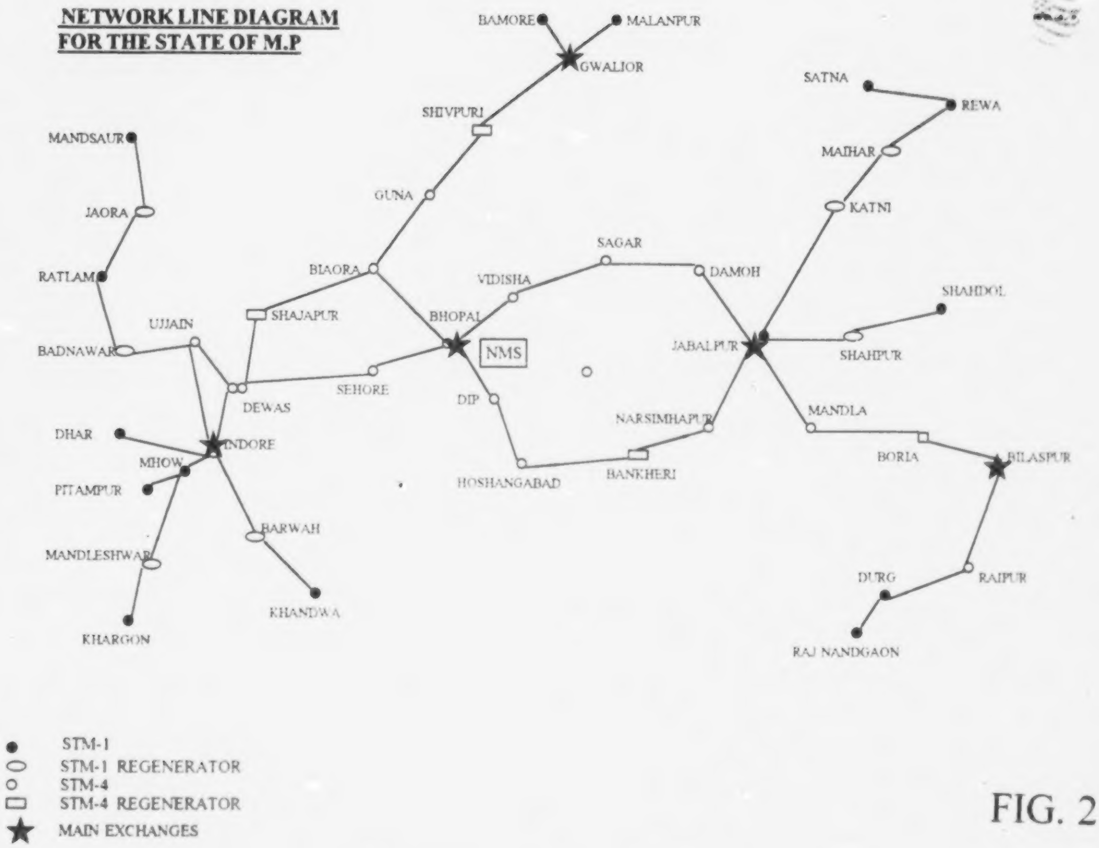

NETWORK LINE DIAGRAM
FOR THE STATE OF M.P
BAMORE
MALANPUR
GWALIOR
SATNA
REWA
SHIVPURI
MANDSAUR
MAIHAR
GUNA
KATNI
JAORA
SAGAR
BIAORA
DAMOH
VIDISHA
RATLAM
SHAHDOL
UJJAIN
SHAJAPUR
BHOPAL
JABALPUR
BADNAWAR
NMS
SHAHPUR
SEHORE
DEWAS
DIP
MANDLA
DHAR
INDORE
NARSIMHAPUR
MHOW
BORIA
BILASPUR
PITAMPUR
HOSHANGABAD
BANKHERI
BARWAH
MANDLESHWAR
DURG
RAIPUR
KHANDWA
KHARGON
RAJ NANDGAON
● STM-1
⬭ STM-1 REGENERATOR
○ STM-4
▭ STM-4 REGENERATOR
★ MAIN EXCHANGES

FIG. 2

638

distribution cables which are armoured are directly buried. In the subscriber network, at times, two flexibility points are provided by a cabinet and a pillar. In large towns with large subscriber concentration only one flexibility point i.e cabinet is provided.

5. P-Telcos. philosophy :

The planning of the network of a private telecom. operator will have to be based on an entirely different philosophy as is existing in the Dept. of Telecom. A private telecom. operator can neither afford to have a large number of exchanges all over the franchise area (as will be seen the average capacity of a DOT exchange is less than 800 lines) nor would he like to have a large number of staff for operation and maintenance of network . (DOT even now engages a staff of 550,000 for 15 million working lines i.e. per person about 27 direct exchange lines). This figure has considerably improved from a previous figure of a staff for just 10 lines.)

The private telecom. operator will set up only a few large capacity electronic exchanges in the franchise area which will correspond to a geographical state in India. For finalising city location of these exchanges , generally a state has been divided into several smaller areas, each area to cover a cluster of towns. The largest of the towns in each cluster will have a large capacity main electronic exchange . Figs. 2 & 3 give tentative location of exchanges in two states as are being planned by the private telecom. operators. This exchange will be connected to other large capacity exchanges with high capacity backbone fibre links capable of carrying telephony, data and video signals . Initially STM-4 systems will be installed for back bone route and the fibre cables of 12/24/48 fibre capacities will be deployed . These fibre links will be closed subsequently into a ring form with digital cross connects and several such rings will constitute the backbone network.

The subscribers access network will have to cover the entire population of the larger of the towns in which the main exchange has been installed as well as other towns in the cluster. For the largest town in the cluster to provide subscriber access fibre ring will have to be installed and on this fibre ring, at say every few kilometre distance based on the network planning there will be a RLU or DLC connected to the main exchange through V.5.1/5.2 and E1 interfaces. Within 500 m radius of RLU and DLC wireline connectivity is provided as shown in the schematic figure 4. Within 2 km radius of the ADM node on the fibre ring, DECT /PHS systems will be provided and for longer distances and for a few and scattered subscribers CDMA/TDMA technology based connectivity is being planned. For other towns in the cluster which may be farther off the reach of WLL system, either a RLU or a DLC system parented to the main exchange through a fibre or a short haul radio link will be set up. From the RLU/DLC node subscribers premises will be reached through conventional wireline system.

6.0 Subscribers Access or Local loop.

Though the local loop forms a minor link in the overall network, but this accounts for almost half the initial investment in a telecom. network and a major portion of the maintenance and operating costs. In most of the developing countries, this was considered a low technology job and did not get the attention it deserved and consequently tends to be the weakest link in the network which is also at times called the "last mile problem". A large workforce is employed to keep the subscribers network in fault free condition which is at times counter productive and results in subscriber harrasement complaints.

The private telecom. operators will have to use technologies given in figure 4 in order to meet the tender conditions as well as make the subscriber loop capable of receiving broad band signals as and when required and also to have a fast rollout . A meticulous combination of wireline including fibre cable and wireless technologies is therefore being planned by the new operators.

6.1 Wire Line : The wireline access is for the last 500 meters . Depending upon the capacity of RLU or DLC a flexible or a

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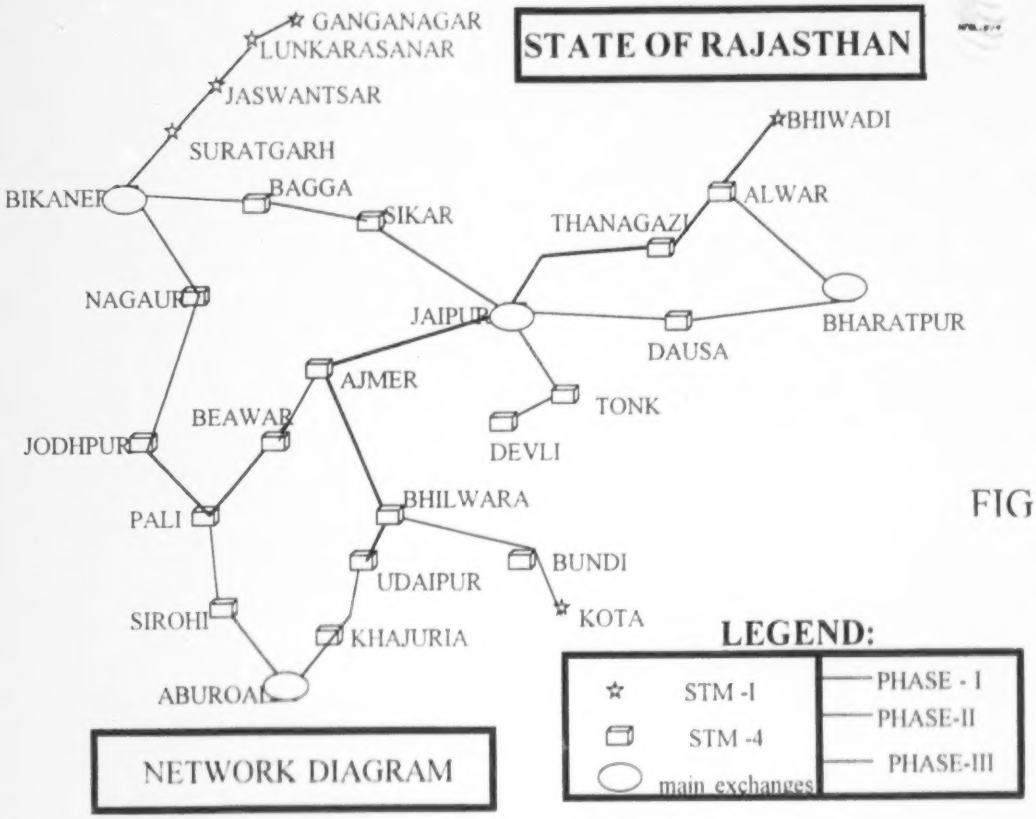
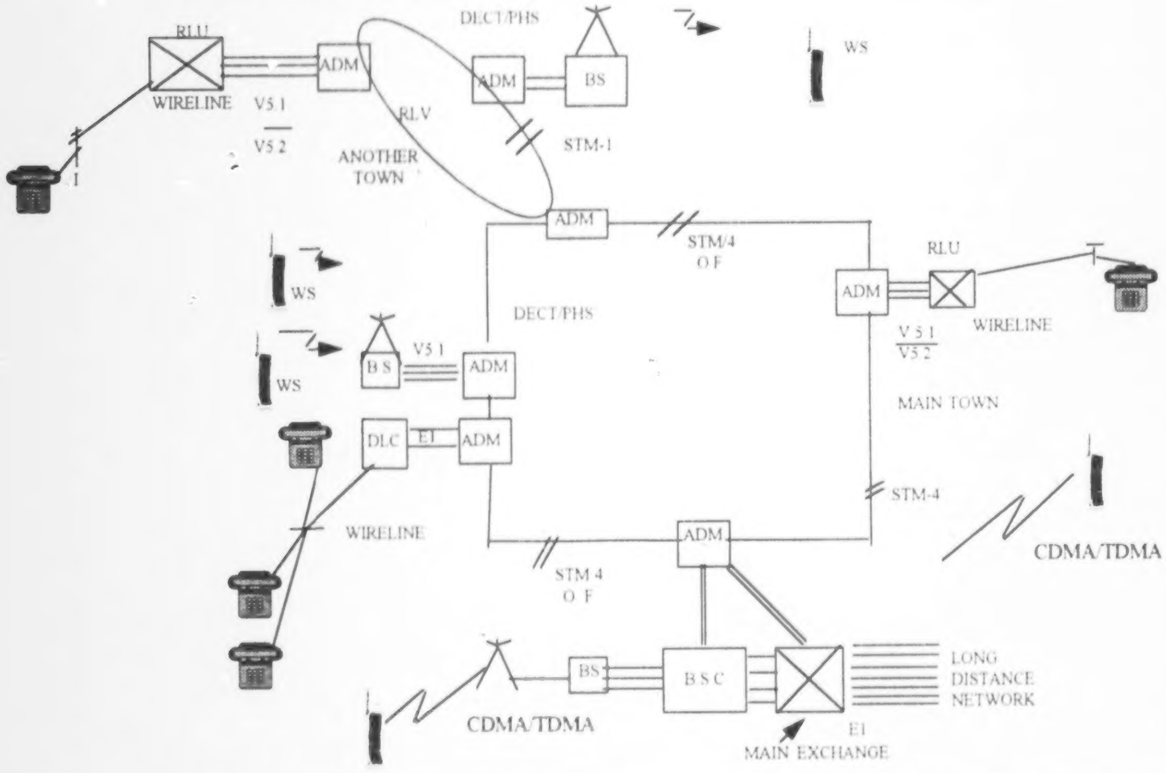

STATE OF RAJASTHAN
GANGANAGAR
LUNKARASANAR
JASWANTSAR
SURATGARH
BIKANER
BAGGA
SIKAR
BHIWADI
ALWAR
THANAGAZI
NAGAUR
JAIPUR
DAUSA
BHARATPUR
AJMER
TONK
DEVLI
BEAWAR
JODHPUR
PALI
BHILWARA
BUNDI
UDAIPUR
KOTA
SIROHI
KHAJURIA
ABUROAD
LEGEND:
☆ STM -I
STM -4
main exchanges
PHASE - I
PHASE-II
PHASE-III
NETWORK DIAGRAM

FIG. 3


RLU
WIRELINE
V5.1
V5.2
ADM
RLV
ANOTHER TOWN
DECT/PHS
ADM
BS
WS
STM-1
ADM
STM/4 O F
RLU
ADM
WIRELINE
V5.1
V5.2
WS
DECT/PHS
WS
BS
V5.1
ADM
MAIN TOWN
DLC
E1
ADM
WIRELINE
STM-4
CDMA/TDMA
ADM
STM 4 O F
BS
BSC
LONG DISTANCE NETWORK
CDMA/TDMA
E1
MAIN EXCHANGE

SCHEMATIC OF SUBSCRIBER ACCESS NETWORK NETWORK ARCHITECTURE
(INDICATING WIRELINE & WIRELESS ACCESS) FIGURE 4

fixed copper cable network is being provided. If the capacity of RLU is within 250 lines; the copper cables of 50/100 pairs get terminated on the MDF and on the subscriber side on DPs having 10,20 or 50 pair capacities . From DPs drop wires are provided in single span to the subscriber's premises terminating in the window terminal . From window terminal internal wiring is carried out to the subscribers house which gets terminated in a telephone instrument . In large capacity RLUs having subscribers termination of more than several hundred lines a flexibility point may be provided by installing cabinets having 200/400 pair terminations. From these cabinets 100 pair or lower pair cables are drawn which get terminated near subscriber's premises in 10/20 pair outdoor DPs . From DPs the connectivity to subscriber's premises is provided through Drop wire. (Figs. 5 and 6).

6.2 Wireless Technology or WLL .

The advantages and benefits of wireless in local loop over the traditional wired systems are too obvious for a new telecom . operator and have spurred a number of manufacturers to come out with innovative solutions. Wireless applications can be implemented to more closely match the growth profile of new subscriber subscriptions . Initially a minimum number of large coverage cells (say for a distance of 20 km) can be deployed to encompass the serving area and as the subscriber growth exceeds the capacity of the initial cell, further cell additions can be done to match the capacity demands . For areas with a low population density where the subscribers are dispersed extensively, digital radio concentrator systems will provide economical solution. However, for WLL systems the practical applicability , the economics , the technology aspects , the operational and maintenance issues are yet to be fully sorted out . The WLL systems which are commercially available are mostly derivatives of the cellular mobile or cordless telephone systems . There is little doubt that wireless technologies will be dominant during the initial years but choosing a solution or several solutions needs careful study and good planning . Some of the issues that need consideration in the choice of technologies or systems are,

- The WLL system must provide PSTN voice quality facsimile and data capability with scope for introduction of ISDN.
- Initial investment & operating costs will have to be comparable to traditional networks. This is particularly relevant for subscribers terminals in case of radio networks .
- Suitable and dependable arrangement for power supply at subscriber terminal is required.
- System should provide the flexibility and scope for expansion.
- Availability of frequency spectrum.

The basic philosophy behind providing wireless access systems is not only to provide a simple telephone connection without wires to a subscriber but to provide all wireline services with the same high quality and that too without wires. The new operator will target high revenue generating subscribers by providing high bit rate services because it is competing against the established telecom network operator and two mobile operators in each area. He can not therefore ignore these demands particularly in urban areas. The schematic of a layout of the wireless local loop concept is given in fig.7.

Based on the above several WLL systems are being considered . A brief description of each type is given below.

6.2.1 DECT Digital Enhanced Cordless Telephone:

A fast rollout using DECT system can be implemented through a cluster of Base Stations at a central location providing a typical coverage of 5 km line of site for fixed - telephony application . Each cluster can support between 500 to 3000 subscribers depending on, whether a single cell or a sectored cell approach (6 sectors) is deployed. A network configured around such clusters can support subscriber

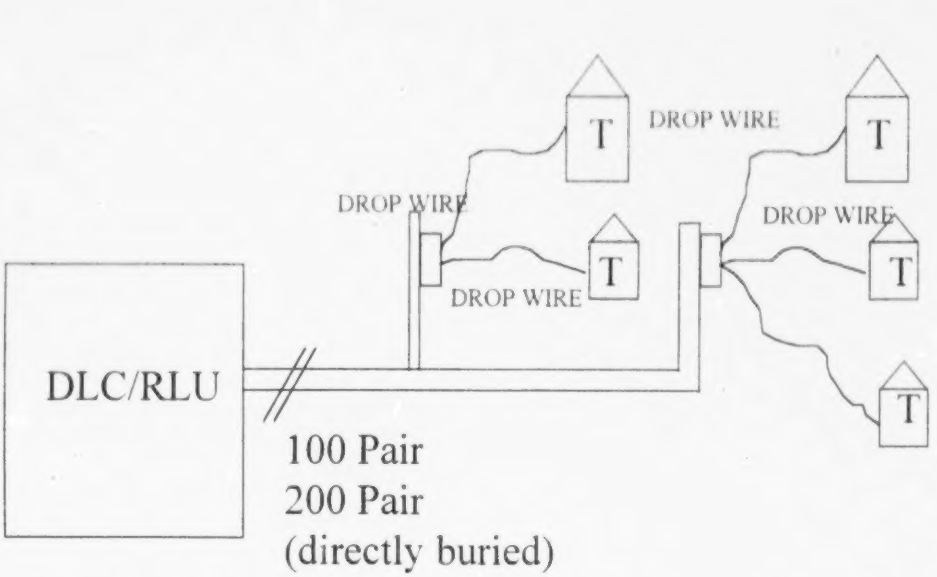

T
DROP WIRE
T
DROP WIRE
DROP WIRE
T
DROP WIRE
T
DLC/RLU
T
100 Pair
200 Pair
(directly buried)

FIGURE 5

WIRELINE CONNECTIVITY BY P-TELCO
WITHIN 500 M OF RLU/DLC HAVING
≤ 250 LINE CAPACITY

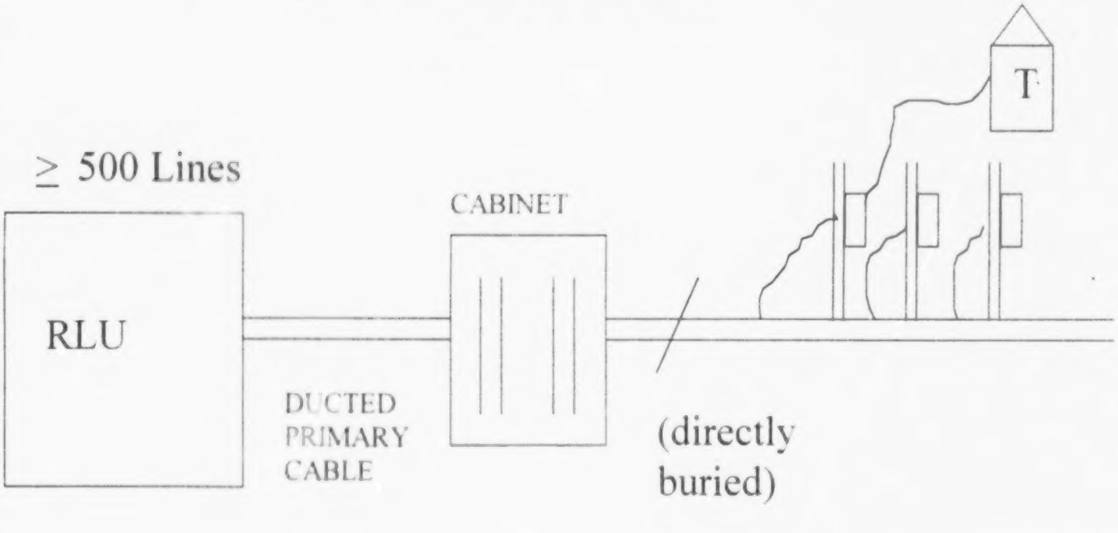

≥ 500 Lines
T
CABINET
RLU
DUCTED
PRIMARY
CABLE
(directly
buried)

FIGURE 6

WIRELINE CONNECTIVITY BY P-TELCO
WITHIN 500 M OF RLU/DLC HAVING
≥ 500 LINE CAPACITY

WIRELESS LOCAL LOOP CONCEPT

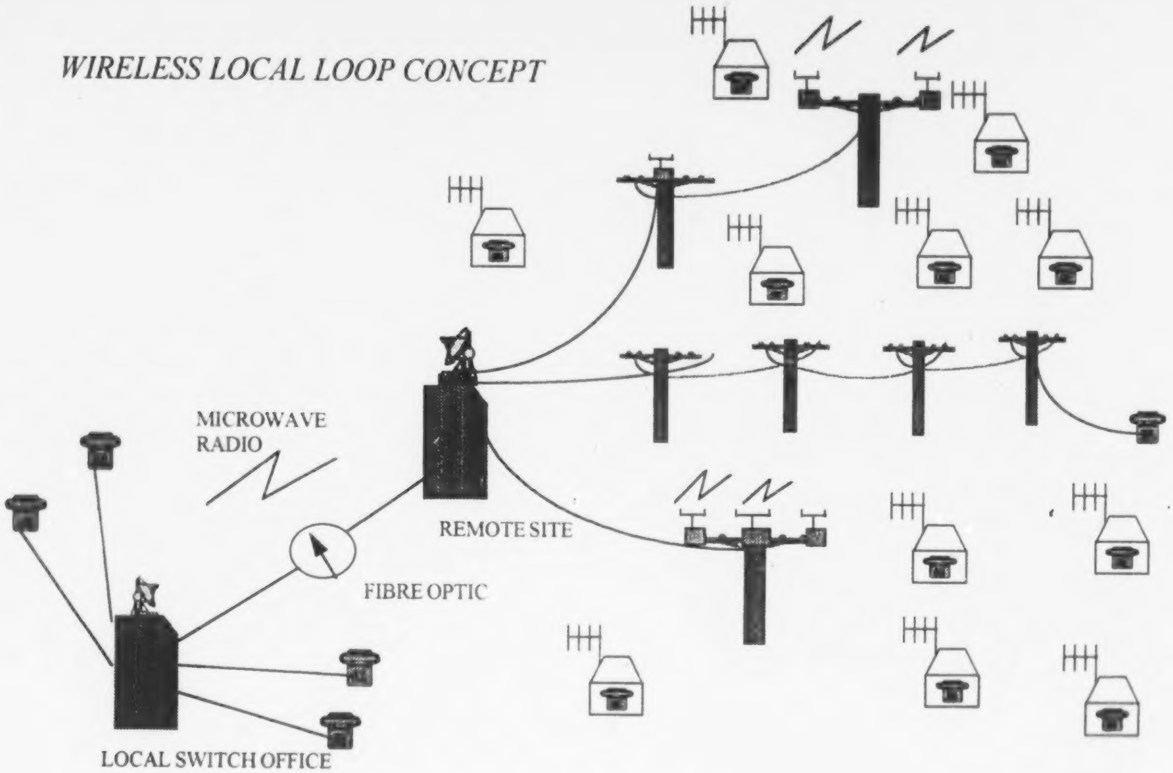
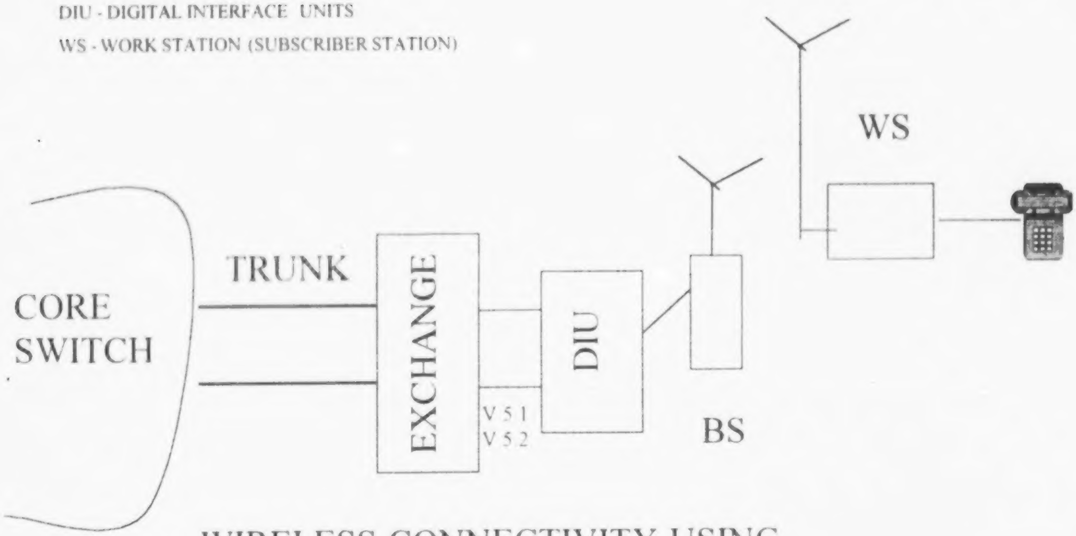

MICROWAVE
RADIO
REMOTE SITE
FIBRE OPTIC
LOCAL SWITCH OFFICE

FIG. 7

LEGEND
BS- BASE STATION
DIU - DIGITAL INTERFACE UNITS
WS - WORK STATION (SUBSCRIBER STATION)


WS
TRUNK
CORE
SWITCH
EXCHANGE
DIU
V 5 1
V 5 2
BS

WIRELESS CONNECTIVITY USING
DECT/PHS SYSTEM

FIGURE 8

densities from low say 1.5/sq. km to higher subscriber densities upto 10,000 / sq. km by evolving into a micro/pico cellular architecture to provide coverage. A well configured DECT system can therefore not only provide a rapid roll out but also a system that can grow with the subscriber base.

DECT provides 32 Kbps AD PCM voice coding providing toll quality voice directly connectable to telephone , FAX , EPABX just like a wireline telephone line. It can also provide ISDN , Internet and will integrate seamlessly with PCS whenever required. It is based on open system concepts such as the International Standards V5.1 and V5.2. Typical schematic of a DECT system is given in fig.8.

6.2.2. PHS : Personal Handyphone System

PHS has been the most successful WLL technology in Japan . A number of Japanese companies are manufacturing this equipment and providing their low cost answer to mobile systems and fixed wireless systems developed in European and American countries. PHS System operates in 1895 to 1906.1 MHz sub-divided into 77 radio frequency carriers, each 300 KHz wide and uses TDMA/TDD structure with 4 receive and 4 transmit time slots per radio frequency carrier. The PHS like the DECT system also provides wireline voice quality with 32 Kbps ADPCM supporting POTS, Fax & modem services . There is dynamic channel allocation and automatic and flexible use of frequencies avoiding frequency reuse planning . Every user has access to all channels (77x4) at all times on overlapping base station. The system is capable of taking high traffic density from 0.05 to 0.15 Erlang and ideal for urban and sub-urban areas. It has a compact out door radio port with remote power feeding. It is a flexible system which supports a wide range of advance features & future services. A typical layout of the system is the same as for DECT system . Regarding the introduction of this technology in India Department of Telecom , like the Japanese administration has standardised GSM for mobile applications and has indicated PHS can be considered for fixed wireless applications.

6.2.3. CDMA : Code Division Multiple Access:

This technology has been used in military satellite communications for decades . Seeing its potential for wireless applications Qualcomm has refined the technology to a superior, cost effective and subscriber oriented wireless system. It is also known as IS-95.

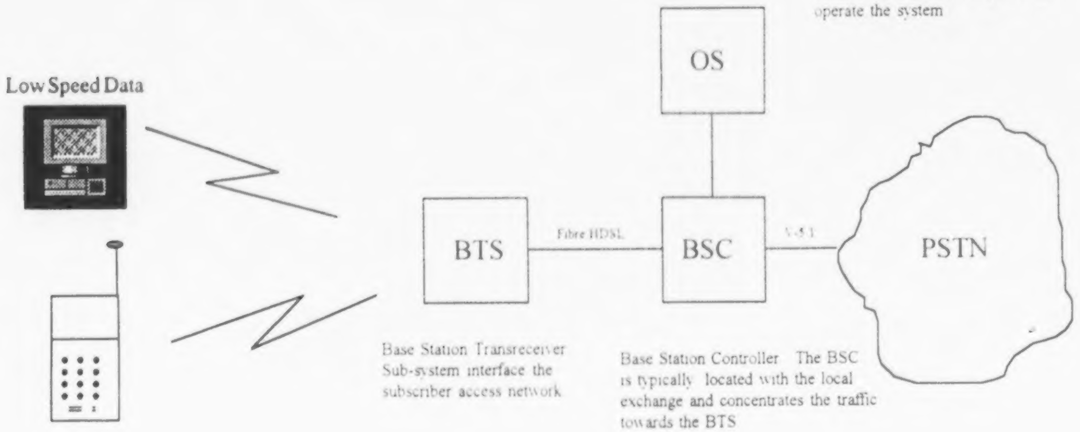
The CDMA uses spread spectrum technology to break up speech into small digitized segments and encode them to identify each packet. This packet generated by the handset is recognised by the receiver . CDMA also uses a wideband signal (at 1.25mhz) and the receiver cell scans the bandwidth , ignoring all other noise until it finds a signal with the identifier code it is looking for . The CDMA link consists of Base Trans Receiver sub system (BTS) and Base Station Controller (BSC) which is connected to the PSTN network through V 5.1 (fig 9) . The system architecture simplifies network growth without service interruptions . The appropriate sub systems can be expanded without reconfiguring the entire system . The architecture also permits rapid implementation of new services and new technological advances in the public networks.

An innovative version of CDMA technology is B-CDMA, especially developed for radio in local loop . This system supports long range radio links as well as large number of subscribers per cell for urban areas and provides necessary bandwidth to offer a wide variety of services.

6.2.4 TDMA : Time Division Multiple Access:

This technology also known as IS-136 being extensively used for WLL networks in Europe and the driving force behind this technology is Universal Wireless

CDMA/TDMA SYSTEM CONFIGURATION



Operation System The OS performs all operations, administrations and maintenance functions required to operate the system

Base Station Transreceiver Sub-system interface the subscriber access network

Base Station Controller The BSC is typically located with the local exchange and concentrates the traffic towards the BTS

FIGURE - 9

	DECT	PHS	CDMA
1 Frequency	1 9 GHz	1 9 GHz	800 MHz
2 Voice codec	32 KBPs	32 KBPs	9 6 to 10 KBPs
3 Duplex method	TDMA/TDD	TDMA/TDD	CDMA
4 Frequency planning	Dynamic channel allocation	Dynamic Channel Allocation	No frequency planning is required
5 Cell site radius	2-3 km	1-2 km	10+km
6 Mobility	Walking speed/seamless hands off	Walking speed/ interruption upto 1 5 sec in hands off	Mobile/ Seamless hands off
7 Hand set weight	100 gm	200 gms	200 gms
8 Manufacturers	A no of manufacturers Siemens, Alcatel , LME, Nokia, Philips etc .	NEC/Fujitsu	Qualcomm Motorola
9 DATA transmission	Supports telecom protocals like 15 DN , X-25, X-400 & GSM	data transmission capability of 32 KBPs but unable to communicate over common data standards	Fax and data transmission are being tried out

Table 1

Communications (UWC) . The System concept is basically the same as in other WLL systems except the modulation techniques . The proponents of TDMA see it as natural migration for operators using AMPS now. However, the number of subscribers which can be provided in the fixed band width is higher in CDMA as compared to TDMA.

7. A brief comparison of the three wireless systems being field trial in India in the subscribers loop is given in Table 1.

8. Conclusion:

The private telecom. operators will have to provide digital switches with ISDN capabilities and for long distance high capacity fibre links. For the subscriber access networks, for a fast initial rollout of the network and having capability close to wireline and in order to draw out business and high paying subscribers, from the existing operator the P-telco. will have to utilise DECT/ PHS technologies . However, for remote and semi-urban areas where provision of plain telephone service is the priority the Digital concentration systems or the CDMA technology will have to be utilised. The wireline access for the last 500 meters will be provided either on copper or on Hybrid fibre coaxial cables (HFC) wherever RLU and DLC have been used . As the network matures and fibre rings in urban areas are laid, wireline access with copper wires or HFC will be provided and WLL systems shifted to other virgin areas.

ACRONYMS

DOT	Department of Telecommunications - Govt. department operating telecom. services in India.
FTTC	Fibre to the curb
FTTO	Fibre to the Office
WLL	Wireless in Local Loop
PDH	Plesciochronous Digital Hierarchy
VSNL	Videsh Sanchar Nigam Ltd., Govt. Company for operating overseas communication services in India.
STM	Synchronous Transport Mode
P-Telcos	Private Telecom. Operators
RLU	Remote Line Unit. A small capacity exchange parented to a main exchange .
DLC	Digital Line Concentrator
DECT	Digital Enhanced Cordless Telecommunications.
CDMA	Code Division Multiple Access.
TDMA	Time Division Multiple Access
MDF	Main Distribution Frame
DPs	Distribution Points.
PSTN	Public Switched Telephone Network.
ISDN	Integrated services digital Network.
FAX	Facsimile
EPABX	Electronic Private Automatic Branch Exchange.
ADPCM	Adaptive Delta Pulse Code Modulation.
PCS	Personal Communication Service.
TDD	Time Division Duplex.
POTS	Plain Old Telephone Service
DIU	Digital Interface Unit
BS	Base Station
WS	Work Station. (Subscriber Station).
HFC	Hybrid fibre coaxial
AMPS	Advanced Mobile Phone Services.

Cable Telephone Services in Japan

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1. Abstract

Following the UK, cable telephone services in Japan were started in June 1997. This article will present an overview of the existing state of cable TV industry and cable telephone services in Japan. In particular, this article will focus on cable TV operator strategies to get into the telecommunications market and telecommunications operator reaction. Other countries can learn from Japan's experience to reduce the uncertainties and costs resulting from the convergence policies of cable TV and telecommunications networks.

2. Introduction

Japan's cable TV Industry has suffered huge deficit over the last decade. The main reason for this is poor subscription growth rate, due to the various programs of the existing terrestrial TV channels, which have well satisfied audience needs.

To resolve the accumulated deficits at an early stage and to facilitate the spread of cable TV services, Japan's cable TV operators are trying to break into the telecommunications market. In particular, they plan to offer telephone services and Internet access services via their existing cable TV networks. Japan's cable TV operators were influenced by the success of the UK cable operators in cable telephone service provision.

On the other hand, the Ministry of Posts and Telecommunications(MPT) has adopted various political measures to support the cable TV industry and to utilize cable TV networks as an information infrastructure. The MPT permitted cable TV operators to offer telecommunications services and to interconnect with telecommunications networks in 1993. Moreover, The MPT is providing financial support, including low-interest-rate loans and tax reductions, to cable TV operators when they install the fiber-optic cables, or improve the reliability of their networks.

This article will present an overview of the existing regulation policies governing the cable industry, and the existing state of the cable TV industry and cable telephone services in Japan. In particular, this article will focus on cable TV operator strategies to get into the telecommunications market and telecommunications operator reaction. Other countries can learn from Japan's experience to reduce the uncertainties and costs resulting from the convergence policies of the cable TV and telecommunications networks.

3. Current situations of the cable TV industry in Japan

Japan's first cable TV system was installed in the mountainous hot spring area of Ikaho-Onsen, Gunma Prefecture, in 1955. The early cable TV systems were developed to cover areas which had problems in receiving the main terrestrial television services.

After 1983, urban-type multi-channel cable TV systems started up services in major urban areas. According to the MPT definition, a cable TV system with more than 10,000 outlets, with interactive network capacity and providing more than five channels(except retransmission channels) is styled urban-type cable TV(hereinafter urban cable TV).

Cable TV systems with more than 500 outlets are regulated by the MPT. A construction permit is required to establish such a system. Systems with between 50 and 500 outlets needs only to register with the MPT, and no regulations govern systems with fewer than 50 outlets. As of fiscal year 1995(the Japanese fiscal year starts in April), there are 1,738 cable systems with permits(including 160 urban cable TV systems), and more than 63,000 cable systems with registered or non-regulated facilities(see Table 1).

The number of cable TV subscribers has increased steadily, albeit very slowly. As of fiscal year 1995, cable TV subscribers numbered about 11 million or about 31.1% of all television households in Japan. The average number of subscribers per system is only 172 subscribers. This means that Japan's cable TV industry is extremely fragmented, comprised of more than 60 thousand systems. On the other hand, as of fiscal year 1995, the urban cable TV subscribers numbered about 3 million or about 8.6% of all television households. The 160 urban cable systems each have about 18,800 subscribers, on average(see Figure1).

Most of the urban cable TV operators in Japan have suffered huge deficits over the last decade. As of fiscal year 1995, total revenue of the 160 urban cable operators accounted to 105.5 billion yen. However, only 61 of these operators made a net profit and the other 99 operators registered a total deficit of 12.1 billion Yen(see Table 2).

To liquidate the accumulated deficit at an early stage and to facilitate the spread of cable TV services, Japan's urban cable TV operators are trying to break into the telecommunications market. In particular, they plan to offer telephone services and Internet access services via their existing cable TV networks. Experts anticipate that urban cable TV operators could eliminate their accumulated deficits on around 2005. However, If cable Telephone services and Internet access services prosper, they could liquidate the accumulated deficits at an earlier date.

4. Deregulation Policies of MPT

The MPT, which now regulates telecommunications and broadcasting services, strictly regulated the cable TV industry until December, 1993. Until that time, the MPT had imposed local ownership principle, and prohibited Multiple System operators(MSO) and telecommunications services from being provided over cable TV networks.

However, in December, 1993, the MPT declared deregulation policies to promote Japan's cable TV industry which was lagging behind the other developed countries. The following is a summary of the deregulation policies which have been announced by the MPT since December, 1993.

Table 1. Cable systems in Japan, 1990-1995

type of system	1990	1991	1992	1993	1994	1995
total	50,448	53,603	56,437	58,950	61,606	63,963
permit required	1,091	1,261	1,371	1,491	1,623	1,738
registration required	27,869	29,173	30,400	31,599	32,747	33,782
neither permit nor registration required	21,488	23,169	24,666	25,860	27,236	28,443

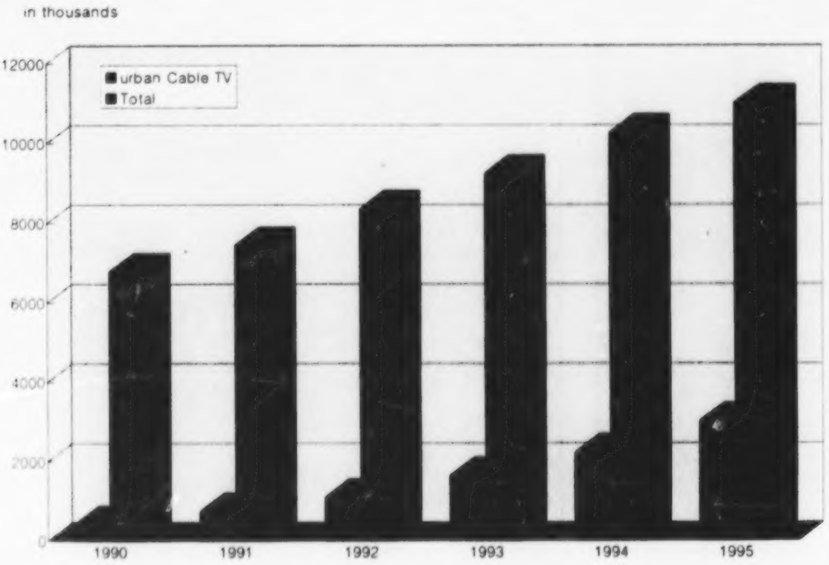

Figure 1. Cable TV subscribers in Japan, 1990-1995

Table 2. Present business situation with respect to the urban cable TV

periods of business	number of operators			total
	A*	B**	C***	
shorter than 3 years	21	2	2	25
longer than 3years	37	17	1	55
longer than 5years	40	22	6	68
longer than 10years	1	4	7	12
total	99	45	16	160

* A : operators who registered deficits in fiscal year 1995 and have been suffering from accumulated deficits.
** B : operators who made net profits in fiscal year 1995, but are still suffering from accumulated deficits.
*** C : operators who made net profits in fiscal year 1995, and have no accumulated deficits.

- Cable TV promotion policies(7 December 1993)

The MPT permitted the creation of MSO, and abolished the local ownership principles. Furthermore, the MPT relaxed foreign ownership regulations lifting the ceiling from 20% to 33%. Following these deregulation policies, large domestic companies, such as SUMITOMO, IITOCHU and TOSHIBA, and foreign companies, such as TCI and Time Warner entered the cable TV industry, and created MSOs to provide nationwide urban cable TV services.

- Permission for Type I telecommunication services (29 July 1994)

The MPT permitted urban cable TV operators to provide Type I telecommunications services over cable TV networks(There are two types of carrier in Japan. Type I carriers have telecommunications infrastructures of their own, whereas Type II carriers are forbidden their own infrastructures). As of 7 July 1997, 25 cable TV operators qualified as Type I telecommunications carriers.

- Financial support for urban cable TV operators(1995)

To establish nationwide fiber optic cable networks at an early stage, the MPT announced a financial support system for the urban cable TV operators. According to this system, the urban cable TV operators can access government-provided interest-free loans when they want to lay fiber optic cables as cable TV networks; and can access similar low-interest loans when they want to upgrade their old facilities. Moreover, the MPT grants 20% tax reduction benefits to the urban cable TV operators.

- Announcement of abolition of regulations governing foreign ownership(January 1997)

The MPT has announced that the foreign ownership regulations governing urban cable TV operators with Type I carrier qualifications will be abolished until the end of 1997.

5. Current status of cable telephone services

According to the deregulation policies of the MPT, and to liquidate the accumulated deficits at an early date, the urban cable TV operators in Japan are trying to break into the telecommunications market. In particular, the urban cable TV operators in Japan were influenced by the success of the UK cable operators in 'cable telephone service' provision. Those UK cable TV operators providing cable telephone services earned more than half of their total revenues from their cable telephone services in 1995.

Two of the 25 urban cable operators with Type I telecommunications qualifications have already started telephone services; and another two have started Internet access services. The others are also preparing to enter the telecommunications markets.

- Cable telephone services providers in Japan

At present, there are two MSOs(TITUS Communications and Jupiter Telecom) providing cable telephone services(see Table 4). The main shareholders of TITUS Communications are ITOCHU, TOSHIBA, Time Warner and US West. TITUS Communications started telephone services over cable TV networks in Kashiwa City, Chiba-Ken, in June, 1997. Jupiter Telecom, a company jointly owned by SUMITOMO and TCI, also started telephone services in Tokyo, July, 1997.

The main benefit of cable telephone services is much lower prices compared with existing telephone services, since telephone services are provided through already established cable networks. TITUS Communications hopes to capture more than 20% of NTT's subscribers. TITUS announced, just one month after the start-up of the services, that about 3% of the subscribers of its cable TV services had left NTT to subscribe to its cable telephone services.

- Cable telephone services expansion strategies

One of the most important factors in providing telephone services is service area. However, cable TV operators are limited to providing services in their local franchise area. Therefore, the urban cable TV operators have been trying to interconnect with NTT networks since 1995; and for the first time, TITUS came to an interconnection agreement with NTT in December, 1996(see Table 3).

To expand their service areas, in addition to interconnecting with NTT, the urban cable TV operators are trying to create MSO's and to tie up with neighboring operators. There are two MSO's(TITUS and Jupiter) in Japan(see Table 4). As mentioned above, MSO's in Japan were initiated by the USA's cable TV operators after December, 1993, when the MPT permitted the creation of MSO's and abolished the principle of local ownership. On the other hand, independent operators not possessing the capacity to create MSO's are tying up with neighboring operators. For instance, 6 urban cable TV operators in Tokyo have entered into an agreement for mutual cooperation, which includes the establishment of joint maintenance center, and sharing of service areas and telecommunications services know-how.

Above all, the most attractive aspect for users is service charges. The principal benefit provided by cable telephone services is much lower prices compared with the existing telephone services, since telephone services are provided through already established cable networks. In the case of TITUS, it set up a lower tariff scheme than that of NTT, averaging about 20%. In particular, the cable telephone service installation fee charged by TITUS is no more than one tenth that of NTT(see table 5). On the other hand, Jupiter has also set up lower tariff rates than NTT, a minimum 5% and maximum 40% cheaper.

- Internet access services

Cable TV operators are providing Internet access services via cable TV networks. As of July 1997, there were two cable TV operators providing Internet access services, and about 14 operators preparing to provide Internet access services. For the first time in Japan, 'KINTETSU CABLENET' started Internet access service in April, 1996, and secured 1,100 subscribers just three month after starting of service. The service access charges are 5,000 Yen for registration and a monthly fixed charge of 10,000 Yen. The operating speed for both services, down stream and upstream, is 10Mbps.

Table 3. Access charges between NTT and TITUS Communications

type of services		charge per line	charge per second
Inter -prefecture	local inter-prefecture service	1.27 yen	0.082 yen
	long distance inter - prefecture service	3.01 yen	0.1429 yen
intra -prefecture	~ 60m	3.80 yen	0.1589 yen
	~ 160km	3.91 yen	0.1819 yen
	longer than 160km	4.27 yen	0.3017 yen

Table 4. MSO's in Japan

company	date of founded	major shareholders	investment plans(1995)	affiliated operators
TITUS Communications	January, 1995	ITOCHU, TOSHIBA, Time Warner, US West	40 billion yen over next five years	26 operators
Jupiter Telecom	January, 1995	SUMITOMO(40%)TCI (40%)	50 billion yen over next five years	19 operators

Table 5. Cable telephone service tariffs.

type of service		TITUS	NTT
local calls	between cable telephone subscribers	2 Yen(per minute)	10 Yen(every 3 minute)
	with NTT subscribers	1 Yen(every 20 seconds)	
long-distance calls (longer than 160km, peak-time)		80 Yen(every 3 minute)	140 Yen (every 3 minute)
installation fee		5,800 Yen	72,000 Yen
monthly basic rate		1,600 Yen	1,750 Yen

6. Reactions of the existing telecommunications operators

As the entrance of new long distance carriers has brought about charge reduction competition in the long distance telephone market, the entrance of urban cable TV operators into local telephone market raises the possibility of similar charge reduction competition in the local telephone market. Therefore, NTT, which is facing new competitors in the local call market, is watching developments. However, because cable telephone operators can be big users for NTT's telecommunications networks, NTT is taking a positive attitude to interconnection requests from cable telephone operators. Moreover, NTT plans to induce cable telephone operators to use NTT's FTTH networks for their cable TV services and cable telephone services. NTT has announced that it will provide an FTTH network to 'Town TV YOKOHAMA', an urban cable TV operator. Town TV YOKOHAMA plans to provide telephone services and cable TV services through this network.

On the other hand, the New Common Carriers(NCCs) in the long distance market plan to use the cable TV networks as subscriber access lines. Among these, Japan Telecom(JT), a long distance carrier, has adopted the most positive attitude towards using cable TV networks. JT has already come to an agreement with ITJ, an international telephone operator, to merge in October, 1997. If JT secures subscriber network, it can complete entire networks, from local to international. Therefore, JT has already invested in 26 cable TV operators, and plans to provide nationwide telephone services without using NTT local networks.

7. Conclusion

Following the WTO basic telecommunications negotiations, the telecommunications policies in most countries of the Asia-Pacific region are becoming more competition-oriented. In international, long distance and mobile telephone service markets, competition is already intense, with new operators entering these markets. However, local telephone services are still operating under monopoly systems or de facto monopoly situations, in most countries. The monopoly system governing local telephone service markets is usually justified by some quoted reasons, such as the economies of scale in this market, worries about investment overlaps, and worries about deterioration of universal services. However, as can be seen in the cases of the UK and Japan, these worries can be resolved when we utilize cable TV networks as a local loop. Since the use of cable TV networks allows not only provision of traditional telecommunications services, including voice telephony, but also offer of new multimedia services, we can introduce competition into the local telephone market without investment overlap anxieties, and can help in removing bottlenecks from local loops at an early stage.

The regulatory regimes governing

telecommunications policies in most countries(except for some developed countries, such as the USA and Japan) of the Asia-Pacific region have regarded cable TV networks simply as infrastructures for cable TV services, and have not examined the possibility of using cable TV networks for telecommunications services.
However, the convergence of communications technologies, and in particular, the integration of cable TV and telecommunications infrastructures, is at the very heart of the future information society. The establishment of an appropriate regulatory framework for the Asia-Pacific region which takes account of this phenomenon is urgently required.

References

1. Minoru Sugaya, "Cable Television and government policy in Japan", *Telecommunications Policy*, Vol.19, No.3, 1995.
2. Byun, Jae-Ho, "Regulatory Issues on CATV and Telecommunications Convergence in Korea", *PTC '97 proceedings*, 1997.
3. *Joho Tsushin Handbook 97*, InfoCom Research, Tokyo, 1996.
4. *CATV Promotion Policies*, Ministry of Posts and Telecommunications, Tokyo, 1994.
5. *Business Strategies of Domestic CATV Operators*, InfoCom Research, Tokyo, 1997.

GIBN Multimedia Network Experiments
- ATM Satellite Communication Experiments between Japan and Canada -

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1. ABSTRACT

This paper presents the intercontinental ATM networks experiment using the satellite and terrestrial links that is being conducted by Communications Research Laboratory (CRL) in Japan and Communications Research Centre (CRC) in Canada. We used the HDTV video conference system by using MPEG-2 CODECs. We consider that the network clock synchronization is one of the most important subjects on the worldwide ATM networks which may be difficult to guarantee the end-to-end clock synchronization. We propose the network clock synchronization system at the both end-points by using GPS. We verify the effect of our proposed system on this intercontinental ATM networks experiment.

2. INTRODUCTION

This experiment is part of the Global Interoperability for Broadband Networks (GIBN) project. The GIBN project promotes the establishment of international network links and provides an opportunity to experiment on interconnectivity and interoperability. This project also promotes the rapid development of global standards and encourages the development of new applications for broadband networks.

In the past experiment (see section 4.1), there were some freeze-frames in MPEG video transmission that is attributed primary to the occasional off-sync condition. We consider that the network clock synchronization is one of the most important subjects on the worldwide ATM networks which is difficult to have the end-to-end clock synchronization.

The aims of the present experiment are :
(a) to explore how best to incorporate satellite links with optical fiber links to form the worldwide ATM networks. We propose the network clock synchronization system at the both end-points by using GPS.
(b) to measure the performance degradation of a high quality communication system on the experimental networks. This experiment is the first of the GIBN experiments to evaluate the performance gap between AAL-1 and AAL-5 in a high quality communication system.

The high quality communication system that we developed is an HDTV video conference system that used MPEG-2 CODECs which can compress HDTV signals into CBR data. We can select the AAL types at the CLAD equipment, which exchanges CBR data for ATM cells.

The experimental network is set up between CRL and CRC via an ATM commercial network in Japan, an INTELSAT circuit of 45 Mbps, and the Canadian Network for the Advancement of Research, Industry and Education (CANARIE).

3. EXPERIMENTAL SYSTEM

3.1 NETWORK CONFIGURATION

The ATM network between Japan and Canada can be described as having three segments : the satellite link, the Japan side, and the Canada side. Figure 1 shows the ATM network configuration diagram. The satellite link, constructed using the INTELSAT, operated at DS-3. On the Japan side, the ATM link over NTT's optical fiber network operated at STM-1, which is almost OC-3. On the Canada side, the ATM link over the CANARIE National Test Network operated at OC-3.

3.1.1 SATELLITE LINK CONFIGURATION

The experiment used the INTELSAT 513 at the longitude of 183 deg.E for the relay between Japan and Canada. The INTELSAT satellite operated using C-band towards Ibaraki, Japan and Lake Cowichan, Canada.

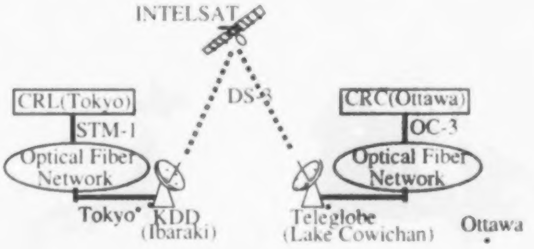

INTELSAT
DS-3
CRL(Tokyo)
STM-1
Optical Fiber Network
CRC(Ottawa)
OC-3
Optical Fiber Network
Tokyo
KDD (Ibaraki)
Teleglobe (Lake Cowichan)
Ottawa

Figure 1. ATM network configuration diagram on Japan-Canada experiment

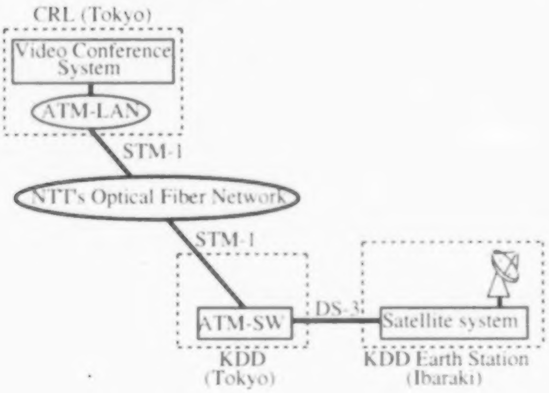

CRL (Tokyo)
Video Conference System
ATM-LAN
STM-1
NTT's Optical Fiber Network
STM-1
ATM-SW
DS-3
Satellite system
KDD (Tokyo)
KDD Earth Station (Ibaraki)

Figure 2. ATM Network configuration in Japan

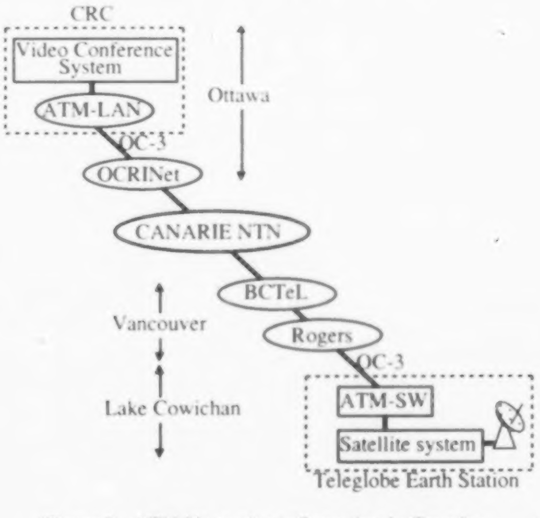

CRC
Video Conference System
ATM-LAN
OC-3
OCRINet
Ottawa
CANARIE NTN
BCTeL
Rogers
Vancouver
Lake Cowichan
OC-3
ATM-SW
Satellite system
Teleglobe Earth Station

Figure 3. ATM Network configuration in Canada

3.1.2 JAPAN SIDE CONFIGURATION

Figure 2 shows the ATM network configurationin Japan. The end-point of the ATM network in Japan was CRL in Koganei, Tokyo. The video conference system and the ATM switch at the CRL were connected at OC-3. CRL was connected to Kokusai Denshin Denwa Corporation (KDD) in Tokyo via Nippon Telegraph and Telephone Corporation (NTT) optical fiber network at STM-1. KDD in Tokyo was connected to KDD earth station in Ibaraki at DS-3. KDD used the exclusive DS-3 modem for the ATM links, which supports the bit interleaving to reduce cell loss.

3.1.3 CANADA SIDE CONFIGURATION

Figure 3 shows the ATM network configurationin Canada. The end-point of the ATM network in Canada was the CRC in Ottawa. The video conference system and the ATM switch at the CRC were connected at OC-3. CRC was connected to the Teleglobe earth station in Lake Cowichan via the OCRINet, the CANARIE National Test Network, the BCTeL and the Rogers at OC-3. The Teleglobe uses the KDD's DS-3 modem.

3.2 HDTV VIDEO CONFERENCE SYSTEM

The HDTV CODEC system supplied by Mitsubishi Electric Corporation is a proprietary piece of equipment implementing an MPEG-2 algorithm format. Analog video signal from the HDTV video camera is used. Analog audio signal input is used, with four audio channels in the MPEG-1 audio mode. The output data rate generated by the encoder is 22.5 Mbps as CBR. Two other output data rates can be selected : 60 Mbps and 120 Mbps. The compressed data is transmitted and received using ATM cells. This CODEC supports two kinds of AAL, AAL-1 and AAL-5, to interface to the ATM network. Tables 1 and 2 show the specifications of the HDTV video conference system equipment.

Table 1. Specification of HDTV CODEC system

Transport Stream rate	22.5 Mbps
Video encode	MPEG-2 Main_Profile@High_Level
Chroma format	4:2:2
Horizontal size	1920 pixels
Vertical size	1080 lines
Frame rate	60 frame/s
Audio encode	MPEG-1 Audio_Layer2
Audio rate	768 Kbps (4 channel)
ATM interface	AAL-1, AAL-5

Table 2. Specification of HDTV video camera

	Japan	Canada
Title	Sony HDC-750	Victor KH-100
Device configuration	2/3-inch FIT CCD x3 IT	2/3-inch CCD x3
Picture elements	1920(H) 1035(V)	960(H) 1035(V)
Horizontal resolution	1000 TV lines	750 TV lines
S/N ratio	54 dB	52 dB
Aspect ratio	16:9	
Scanning system	2:1 interlaced, 1125 lines, 60 field/s	
Zoom lens	Cannon HJ18x7.8B	FUJINON AS-15x8BW

Table 3. Specification of NTSC CODEC system

Transport Stream rate	12.03 Mbps
Video encode	MPEG-2 Main_Profile@Main_Level
Chroma format	4:2:0
Horizontal size	720 pixels
Vertical size	480 lines
Frame rate	29.97 frame/s
Audio encode	MPEG-1 Audio_Layer2
Audio rate	384 Kbps (2 channel)
ATM interface	AAL-5

3.3 NTSC VIDEO CONFERENCE SYSTEM

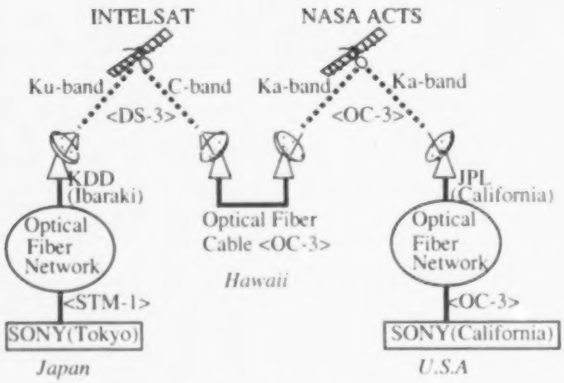
The NTSC CODEC system supplied by Mitsubishi Electric Corporation is a proprietary piece of equipment implementing an MPEG-2 algorithm format (see Table 3). Analog video signal from the NTSC video camera is used. Analog audio signal input is used, with two audio channels in the MPEG-1 audio mode. The output data rate generated by the encoder is 12.03 Mbps as CBR. Several kinds of output data rates can be selected, ranging from 5.184 Mbps to 31.104 Mbps. The compressed data is transmitted and received using ATM cells. This CODEC supports AAL-5 to interface to the ATM network.

4. TECHNICAL ISSUES EXPERIMENTED BY PAST EXPERIMENTS

The ATM satellite communication experiments between Japan and Canada (Japan-Canada experiment) are part of the ATM satellite experiments with the HDTV CODECs. CRL has already completed two experiments in 1997. The results of these experiments show that some technical issues need to be improved. The Japan-Canada experiment was designed taking these results into account. A summary of these experiments follows.

4.1 TRANSPACIFIC HIGH DEFINITION VIDEO SATELLITE COMMUNICATIONS EXPERIMENT (JAPAN-U.S. EXPERIMENT)

This experiment(1) is one of the activities arising from the Japan-U.S. Cooperation in Space Project (JUSTSAP) and is the first in the transpacific series of GIBN experiments. Figure 4 shows the ATM network configuration of this experiment. This experiment tested the ability of satellites to carry HDTV signals between Sony studios in Tokyo and Los Angeles in March, 1997. Japan was linked to Hawaii via the INTELSAT satellite, and Hawaii to California via NASA's Advanced Communications Technology Satellite (ACTS). The HDTV CODEC system is almost equivalent to the Mitsubishi Electric MPEG-2 CODEC system shown in Table 1, except that it only supports AAL-5.


INTELSAT
NASA ACTS
Ku-band
C-band
Ka-band
Ka-band
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KDD
(Ibaraki)
JPL
(California)
Optical Fiber Network
Optical Fiber Cable <OC-3>
Hawaii
Optical Fiber Network
<STM-1>
<OC-3>
SONY(Tokyo)
SONY(California)
Japan
U.S.A

Figure 4. ATM network configuration diagram on Japan-U.S. experiment

The experimental results are as follows.

(a) End to end ATM performance

When it rained or when there was a thick cloud over Honolulu, the ACTS satellite link was observed to have many error bursts. At times asymmetric performance was observed in the ACTS satellite links to/from Honolulu. The optical fiber network did not contribute to the error statistics significantly. These results are consistent with the characteristics of satellite frequencies such as Ka-band.

(b) Analysis of HDTV performance

When the ACTS satellite link was observed to have many errorbursts, the HDTV CODEC failed to extract frame synchronization information, which resulted in many freeze-frames. When the ACTS satellite link was good, the output video from HDTV CODEC had no visible compression artifacts. The only observable effect of the CODEC system and network was the occasional freeze-frame. This effect was attributed primarily to the small buffer size and the occasional off-sync condition. It is considered that the network clock synchronization is one of the most important subjects on the networks which is difficult to have the end-to-end clock synchronization.

4.2 ATM SATELLITE COMMUNICATION EXPERIMENTS IN JAPAN (DOMESTIC EXPERIMENT)

The domestic experiment, the first to use the HDTV CODEC system supporting AAL-1, is a comparative experiment for the Japan-Canada experiment. The domestic experiment, conducted in July and December of 1997, tested the HDTV video conference system shown in section 3.2.

Figure 5 shows the ATM network configurationof the domestic experiment. this experimental network was linked between CRL and NSTAR satellite owned by NTT via the CRL Kashima Space Research Center. The Kashima Space Research Center used the OC-3 modem for ATM links, which supports the bit interleaving to reduce cell loss.

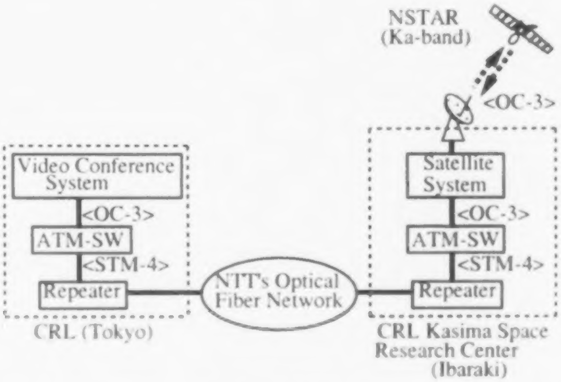
NSTAR
(Ka-band)
<OC-3>
Video Conference System
<OC-3>
ATM-SW
<STM-4>
Repeater
CRL (Tokyo)
NTT's Optical Fiber Network
Satellite System
<OC-3>
ATM-SW
<STM-4>
Repeater
CRL Kasima Space Research Center (Ibaraki)

Figure 5. ATM network configuration on domestic experiment

Table 4. Performance in the irregular state

AAL	AAL-1	AAL-5
Bandwidth of ATM cells	26.19 Mbps	25.37 Mbps
Bit error rate at just before start	1.0E-7 (*)	7.7E-8 (*)
Bit error rate at just after finish	7.7E-8 (*)	6.8E-8 (*)
Count of freeze-frame	19	122
Duration time of freeze-frame	2.54 s (average)	6.77 s (average)
Ratio of freeze-frame	4.0 %	67.6 %

(*) It was very hard to fix the bit error rate in the satellite link, which is measured from the line BIP error ratio on SDH frames, because the transmitting power control is very sensitive and the line BIP error ratio is not stable for a long time.

The experimental results are as follows.

(a) End to end ATM performance

The NSTAR satellite operated using Ka-band towards the Kashima Space Research Center. Then there is a possibility that the satellite link is observed to have many errorbursts when it rained or when there was a thick cloud. The ATM monitoring system detected no cell loss in the ATM network during the domestic experiment.

(b) Performance of video conference system

We evaluated the performance gap between AAL-5 and AAL-1 in the HDTV video conference system. There was no performance gap between AAL-5 and AAL-1 in the regular state. The irregular state, produced by controlling the transmitting power towards the NSTAR satellite at the Kashima Space Research Center, was used to evaluate the performance gap between AAL-5 and AAL-1. Table 4 shows the performance in the irregular state. The results show that the bandwidth is larger when AAL-1 is used than when AAL-5 is used, but the reliability of AAL-1 is higher than that of AAL-5.

5. ATM SATELLITE COMMUNICATION EXPERIMENTS BETWEEN JAPAN AND CANADA (JAPAN-CANADA EXPERIMENT)

The aims of the Japan-Canada experiment are :
(a) to explore how best to incorporate satellite links with optical fiber links to form the worldwide ATM networks. We propose the network clock synchronization system at the both end-points by using GPS.
(b) to measure the performance degradation of a high quality communication system on the experimental networks. This experiment is the first of the GIBN experiments to evaluate the performance gap between AAL-1 and AAL-5 in a high quality communication system.

The practical experiments present as follows.

5.1 END TO END ATM PERFORMANCE

The end to end ATM performance will be measured using ATM analyzers, Hewlett Packard Broadband Series Test System. An ATM analyzer will be installed at each end-point (CRL and CRC). Figure 6 shows the end to end ATM performance monitoring configuration. Table 5 shows the end to end ATM performance of the Japan-Canada experiment.

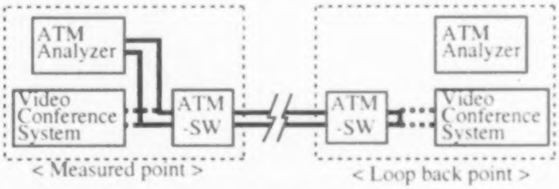
ATM Analyzer
Video Conference System
ATM -SW
ATM -SW
ATM Analyzer
Video Conference System
< Measured point >
< Loop back point >

Figure 6. End to end ATM performance monitoring configuration

Table 5. End to end ATM performance

Measured point	Loop back point	Cell Delay Time (average)	Cell Delay Variation (average)
CRL	CRC	623 ms	21.2 us
CRC	CRL	609 ms	84.8 us

5.2 NETWORK CLOCK SYNCHRONIZATION PERFORMANCE

The HDTV CODEC system supplied by Mitsubishi Electric Corporation was originally designed for use with ATM optical fiber networks. Several freeze-frames were detected every hour in the Japan-U.S. experiment. The Japan-U.S. experiment was constructed from two ATM optical fiber networks and two ATM satellite networks, which did not have the same clock synchronization. We suspect that these freeze-frames can be attributed to the end-to-end clock synchronization and the CODEC buffer pool size. We will develop the network clock synchronization system by using GPS which can establish clock synchronization between CRL and CRC. We will use this system to verify whether these freeze-frames are due to the end-to-end clock synchronization. Figure 7 shows the network clock synchronization system by using GPS. We will verify the effect of this system on the Japan-Canada experiment. This system will be reasonable system because of the use of the GPS system, if this experiment succeed.

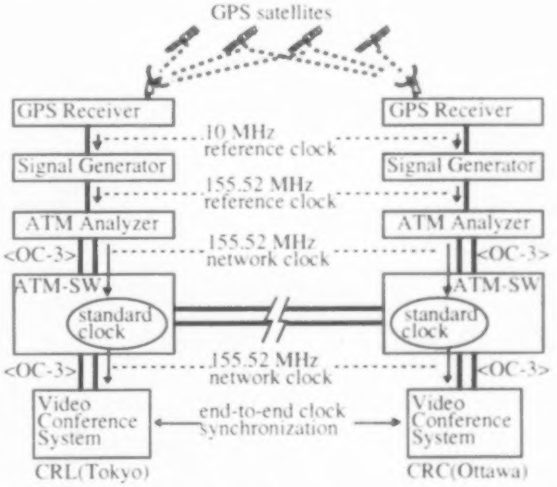
GPS satellites
GPS Receiver
GPS Receiver
10 MHz reference clock
Signal Generator
Signal Generator
155.52 MHz reference clock
ATM Analyzer
ATM Analyzer
<OC-3>
<OC-3>
155.52 MHz network clock
ATM-SW
ATM-SW
standard clock
standard clock
<OC-3>
<OC-3>
155.52 MHz network clock
Video Conference System
end-to-end clock synchronization
Video Conference System
CRL(Tokyo)
CRC(Ottawa)

Figure 7. Network clock synchronization system by using GPS

5.3 PERFORMANCE OF VIDEO CONFERENCE SYSTEM

We will inspect what is important as high quality communication with much presence. We will execute a questionnaire survey with key words such as video quality, voice quality, screen size, for all users used the video conference system.

6. FUTURE WORK

HDTV application experiments are going on. Followed after HDTV video conference experiment, we will verify the Video-on-Demand system by using HDTV images, which based on DAVIC (Digital Audio Visual Council) specifications. As further applications experiments, we will open the long distance lectures and the international workshop at both CRL and CRC sites.

ACKNOWLEDGMENT

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The authors appreciate the tremendous effort and support of all participants in this experiment: the Communications Research Laboratory, the Telecommunications Advancement Organization of Japan, the Ministry of Posts and Telecommunications of Japan, the Nippon Telegraph and Telephone Co., the Kokusai Denshin Denwa Co., the Mitsubishi Electric Co., the Communications Research Centre, the Industry Canada, the Canadian Network for the Advancement of Research, Industry and Education Inc., the Teleglobe, the OCRINet, the BCTeL and the Rogers.

REFERENCE

(1) E. Hsu, C. Wang, N. Kadowaki and T. Takahashi, "Distributed HDV Post-Production over Trans-Pacific ATM Satellites", Proceedings of Third Ka Band Utilization Conference, September, 1997.

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